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A DESCRIPTIVE ACCOUNT OF THE BUILDING RECENTLY ERECTED FOR THE DEPARTMENTS OF NATURAL HISTORY OF THE UNITED STATES NATIONAL MUSEUM

BY

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INTRODUCTION

The building recently erected in the Smithsonian Park in Washington for the natural history collections of the United States National Museum, as the latest of the great museum buildings of the world, and embodying many new and important features, has attracted wide attention and given rise to repeated inquiries regarding its construction and arrangement. The present paper has been prepared to meet this demand, a demand largely inspired by the exceptional activity in museum enterprise which for several years past has prevailed throughout the country.

Of the two older buildings, now to be devoted in greater part to the arts and industries and American history, a descriptive account was given in the annual report of the National Museum for 1903.[1]

By the terms of its fundamental act, dated August 10, 1846, the Smithsonian Institution was made the custodian of the national collections which virtually had their beginning in the results of the United States Exploring Expedition around the world from 1838 to 1842. This act provided that the Board of Regents "shall cause to be erected a suitable building, of plain and durable materials and structure, without unnecessary ornament, and of sufficient size, and with suitable rooms or halls, for the reception and arrangement, upon a liberal scale, of objects of natural history, including a geological and mineralogical cabinet; also a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms;" and further, "that, in proportion as suitable arrangements can be made for their reception, all objects of art and of foreign and curious research, and all objects of natural history, plants and geological and mineralogical specimens, belonging, or hereafter to belong, to the United States, which may be in the city of Washington, in whosesoever custody the same may be, shall be delivered to such persons as may be authorized by the Board of Regents to receive them, and shall be arranged in such order, and so classed, as best to facilitate the examination and

[1] The United States National Museum: An Account of the Buildings occupied by the National Collections. By Richard Rathbun. Pages 177–309, with 29 plates.

study of them, in the building so as aforesaid to be erected for the Institution." To the subjects specifically enumerated in the act, the Regents, under plenary powers granted them, added ethnology and antiquities, inventions, and the arts and manufactures.

The Smithsonian building was not finished until 1855, although collections from Government expeditions and other sources began to be received and cared for in one of the wings as early as 1850. The transfer of the national collections which had previously been preserved in the Patent Office building did not take place until 1858, however, owing to delays in preparing for their accommodation. The space provided in the building for museum purposes comprised, besides limited storage and laboratory facilities, only a single large hall, but in this the public installation, soon arranged, formed an exceptionally important exhibition for that time. Even at that period, however, these collections were growing rapidly, mainly in the line of natural history, and, spreading beyond their allotted boundaries, they encroached so constantly upon the area originally designed and used for the library, the gallery of art and public lectures, that by 1875 the Museum was occupying the entire main part of the building and its western wing, leaving for other purposes of the Institution only the eastern wing and portions of the large towers.

At this period, 1876, occurred the Centennial Exhibition at Philadelphia, the first of the large international expositions to be held in this country, and through its direct participation in that great display of the world's products and activities the Museum was afforded the opportunity for establishing an epoch record in the matter of acquisitions. So extensive, in fact, were the contributions made gratuitously to this Government by both foreign and domestic exhibitors, whose interests had been enlisted in the welfare of the Museum, that they practically filled the so-called Armory building in Washington, which had been secured for their temporary storage. The importance of these additions to the national collections, which related chiefly to the arts and industries of America, Europe and the Orient, was recognized by Congress in 1879 in the provision for the erection of the one story brick structure which stands adjacent to the Smithsonian building. Whatever may be its architectural shortcomings and its deficiencies in laboratory and storage accommodations, this building, completed in 1881, furnishes most excellent exhibition halls to the extent of slightly more than two acres.

In the two buildings thus made available, the older collections were readjusted and the later accessions were installed, but while the floor space had been much more than doubled in extent, its inadequacy to meet the demands was soon apparent. As early as 1883, therefore, the Board of Regents was led to urge upon Congress the erection of a third building, but, although this request was several times renewed,

it was not until a decade ago that favorable action was obtained. In the meantime the collections continued to increase steadily, and the buildings to become more and more crowded, until finally the necessity arose for renting extensive outside quarters in which immense quantities of specimens were stored in bulk, subject to deterioration and in constant danger of destruction by fire.

The conditions had, in fact, reached a critical stage when, in 1902, Congress made provision for the preparation of plans, and the following year authorized the construction of the building which had been so earnestly awaited. Designed on a liberal scale, and as a permanent and monumental feature of the Capital, its completion was not effected until June, 1911, although its occupancy was begun at a considerably earlier date. In the matter of accommodations and appointments, to which long and careful consideration had been given, it appears to be greatly in advance of all other museum buildings intended for a similar purpose, and in every respect to be worthily adapted for housing and exhibiting the collections of a great country. The building marks the beginning of a new era in the history of the National Museum, through the unrivaled conditions presented for the arrangement, care and safety of the collections, for their unrestricted study in the advancement of knowledge, and for their use in promoting the interests of public education.

The growth of the national collections has been most pronounced in the lines of natural history, including primitive man, for the reason that, while only very limited means have been available for acquiring examples of the arts of civilization, the Government surveys and explorations directed toward the discovery and development of the natural resources of the country and the study of the habits and conditions of the American aborigines have been constant and prolific contributors since the early part of the last century. The influx of material from these sources, often operating beyond the confines of the United States, supplemented by many thousands of gifts and exchanges, has built up collections illustrative of nature and of early man which are scarcely if at all surpassed in any other country. Comprising several millions of specimens and several hundreds of thousands of distinct species and forms, they derive their chief value from the fact that a large proportion of the material has served as the basis of extended original researches and discoveries, making its perpetual preservation a matter of extreme importance. It is not, however, solely by the possession of such large and valuable collections that the natural history departments have attained their preponderating position in the Museum, but as much by the close relationship of these departments with important Government work in progress, work underlying many broad economic problems in agriculture, in mining, in fisheries, and in Indian affairs, with which the Museum has been actively associated for over sixty years.

As a result of these circumstances the natural history branches have as a whole become more thoroughly organized than the other branches and their collections have been more completely classified and arranged and more extensively drawn upon for exhibition purposes. They were also in much greater need of better laboratory and storage facilities, and their claims were recognized as paramount in designing the new building, which has been planned almost wholly with reference to their requirements.

As soon as provision for the new building had been assured steps were taken to secure at first hand detailed information regarding all the important museum buildings of Europe and the United States, which were visited both by Museum officers and by the architects. The published plans and descriptions obtainable were supplemented by voluminous notes and many drawings, and it is doubtful if any structures offering possible suggestions escaped attention. In deciding upon the character and arrangement of space for the building, however, reliance was mainly placed upon the actual experience of the Museum staff. The Smithsonian building, to be sure, had been only in part designed for museum purposes and was put up at a time when museum needs were but little understood, while the second building, though possessing many excellent qualities, is rather of the temporary exposition type. Both, however, have furnished many valuable object lessons, teaching perhaps more what to avoid than what to retain, and in the prolonged effort to adapt them to the storage and exhibition of the constantly overflowing collections it was but natural that very definite opinions should have been reached as to the general and detailed requirements of a modern museum.

The earlier plans for the building contemplated somewhat greater dimensions than had finally to be adopted, the deciding factor in this regard being the amount of the appropriation. In conjunction with the architects and the superintendent of construction, the needs of each branch of the collections and of each distinctive purpose of the Museum were carefully and repeatedly considered, and no matters great or small that concerned the production of a structure intended to meet the highest ideals of an establishment of this kind failed to receive their due amount of attention. It is felt that the outcome is satisfactory and that a great advance in museum architecture has been achieved.

The size of the building somewhat obscures the fact that its plan is very simple, and this is one of its most commendable characteristics. Decorative treatment has been generally avoided in the interior, the lighting question has been skilfully handled, and every part of the structure has been adapted to its particular purpose. While nearly one-half of the floor space, comprising the principal stories, has been allotted to the public, the quarters reserved for the storage of col-

lections and for the laboratories are spacious and readily accessible, and by the introduction of a power plant, an auditorium, construction and repair shops, and many other necessities and conveniences, the scheme of a perfected museum building appears to have been quite fully rounded out. For the exterior designs as well as for the more elaborate features and the harmonious arrangement of the interior, which have made it one of the most notable structures at the National Capital, the architects are solely responsible.

Except for delays in securing certain of the structural materials, which somewhat retarded building operations, the work proceeded satisfactorily and is entirely of a high standard and permanent character. It also seems worthy of record that the building was erected within the amount of the appropriation.

The architects of the building were Messrs. Hornblower & Marshall, of Washington, while the heating, electrical and ventilating equipment was designed and installed under the supervision of Prof. S. Homer Woodbridge, of Boston, Mass. The building construction was, by designation of Congress, directed by Mr. Bernard R. Green, Superintendent of Buildings and Grounds of the Library of Congress, whose experience especially qualified him for successfully carrying out this large and somewhat novel undertaking.

In the preparation of this paper, the writer has been dependent upon others for most of the technical descriptive matter incorporated, which was submitted to him in the form of two detailed reports, preserved in the office files. One of these, by Mr. James Millar, formerly of the architects' office, covers the structural details of the building. The other, relating to the mechanical equipment, is by Mr. C. R. Denmark, an assistant of Professor Woodbridge during its installation and at present in charge of its operation, as engineer of the Museum.

LEGISLATION, ACTION BY THE REGENTS, PROGRESS OF THE WORK

Following the preparation of certain tentative sketches designed to illustrate the size and character of structure required for housing the natural history collections of the Government, the matter of providing an additional building for the National Museum was brought to the attention of the Fifty-seventh Congress, First Session (1901–2), in the form of an estimate of appropriation sufficient to cover the expense of making the necessary preliminary plans. With the information then available it had been impossible to determine the cost of such a building, but a limitation in that respect was considered advisable by Congress and was incorporated in the measure which passed as an item in the sundry civil act for the fiscal year ending June 30, 1903, in the following terms:

For the preparation, under the direction of the Secretary of the Smithsonian Institution, of preliminary plans for an additional fireproof steel-

frame brick-and-terra-cotta building, to cost not exceeding one million five hundred thousand dollars, for the United States National Museum, to be erected when appropriated for, on the Mall, between Ninth and Twelfth streets west, said plans when completed to be transmitted by the Secretary of the Smithsonian Institution to Congress, five thousand dollars.

From the detailed inquiries which were at once instituted it was shown that a building of adequate dimensions, even though constructed of brick and terra cotta, could not be erected for the sum stated, at least twice that amount being, in fact, required. The architects were, therefore, instructed to design a building of the full size needed, of which approximately one-half could be erected separately in a manner to permit of subsequent additions, and to prepare two sets of plans, one representing the entire building, the other such part of it as could be completed within the limit of cost prescribed by the act. This was done and the two sets of plans were designated by the letters "A" and "B," respectively.

These plans, together with an explanatory report, were submitted to Congress on January 23, 1903, accompanied by the following resolution by a special committee of six members of the Board of Regents appointed "to represent to Congress the pressing necessity of additional room for the proper exhibition of specimens belonging to the National Museum":

That under the limitations of the law the committee hereby report to Congress Plan B for a new National Museum building as the best obtainable for the amount mentioned; but, in the judgment of the committee, the larger plan, A, is believed to be the one which should be adopted, and we therefore ask that Congress shall make the appropriation for it instead of for the smaller plan.

In the hearings before the House and Senate committees on appropriations, which were held soon afterwards, the larger building was urged as a requirement of existing conditions, and also the use of stone instead of brick and terra cotta for the outer walls, on account of the conspicuous position to be occupied by the building in one of the Government parks. Both of these requests were granted, and the sundry civil act for the year ending June 30, 1904, contained the following item:

To enable the Regents of the Smithsonian Institution to commence the erection of a suitable fireproof building with granite fronts, for the use of the National Museum, to be erected on the north side of the Mall, between Ninth and Twelfth streets, northwest, substantially in accordance with the Plan A, prepared and submitted to Congress by the Secretary of the Smithsonian Institution under the provisions of the act approved June twenty-eighth, nineteen hundred and two, two hundred and fifty thousand dollars. Said building complete, including heating and ventilating apparatus and elevators, shall cost not to exceed three million five hundred thousand dollars, and a contract or contracts for its completion is hereby authorized to be entered into subject to appropriations to be made by Congress. The construction shall be in charge of Bernard R. Green, Superintendent of Buildings and Grounds, Library of Congress, who shall make the contracts herein authorized and disburse all appropriations made for the work, and shall receive as full compensation for his

services hereunder the sum of two thousand dollars annually in addition to his present salary, to be paid out of said appropriations.

Following the passage of this act, the Board of Regents, on March 12, 1903, provided by resolution,

That the Secretary, with the advice and consent of the Chancellor and the Chairman of the Executive Committee, be authorized to represent the Board of Regents, so far as may be necessary, in consultation with Bernard R. Green, to whom the construction and contracts for the new Museum building are committed by Congress in the act making an appropriation for that purpose.

The preparation of the definite and detailed plans was immediately taken up by the architects in conjunction with the Museum authorities, and although the novel character of the building called for more than the usual preliminary considerations, the progress of the work during the early stages was greatly aided by the fact that it was decided to construct the building in the form of a shell, leaving nearly all interior dividing walls to be added in a subsidiary way. At the beginning of the calendar year 1904 the plans had been sufficiently advanced to fix the main lines, the general dimensions and the architectural design, and at this stage they were, on January 27, 1904, approved by the Secretary of the Institution in the manner prescribed by the Board. The elaboration of details naturally continued much longer, and modifications looking to improvements in both the plan and the design were suggested and approved from time to time as the work progressed.

The ground was broken at the site on June 15, 1904, by Secretary Langley, in the presence of the architects, the superintendent of construction and the officers and employees of the Institution. Addressing Mr. Green, he said: "On behalf of the Regents of the Smithsonian Institution, with the consent of the Chancellor and of the chairman of the executive committee, I now authorize you, in accordance with the act of Congress, to proceed with the construction of the new building for the United States National Museum, designed to increase and diffuse the knowledge of the arts and sciences among the people." The excavation was completed during the summer and the laying of the foundations on November 9, 1904. No further building operations were conducted during the fiscal year, but the kinds of granite to be used for the fronts were selected, and contracts were concluded for the stone, for the steel frame work for the main floor, and for much other material.

The first stone, one of the large pieces of the base course in the east range directly adjoining the north pavilion, was laid on August 21, 1905, and by June 30, 1906, the basement walls and piers and the steel work and arches of the main floor, except at the north and south pavilions, had been finished, and work had been commenced on the court walls of the first story. The laying of the corner stone, which took place on October 15, 1906, was conducted without cere-

mony, there being present only the architects, the superintendent of construction, and several Museum officers. The stone selected to serve this purpose is the base stone at the northeast corner of the north pavilion and weighs about 19 tons. In a hole cut in the bottom was embedded a black walnut box, measuring 14¼ by 11¼ by 8¼ inches and hermetically sealed in a covering of sheet lead, in which had been placed a number of documents relating to the Institution and to the erection of the building, partly in the form of electrotypes and partly as matter printed on paper.

During the next two years, ending June 30, 1908, all of the outer and court walls, except those of the south pavilion and rotunda, the erection of which had been retarded by delays in obtaining granite, and also the interior structural walls, piers and floors were completed, and the roof construction was begun. The end of another two years found the entire exterior of the building finished, and while much remained to be done in the interior of the south pavilion, rotunda and auditorium, the wings and ranges composing the main part of the building had been wholly in the possession of the Museum during the greater part of the year 1909–10. Occupation of the third story was obtained on August 10, 1909, and of the other stories on November 9, following, and the installation of the power plant was sufficiently advanced to start the heating of the building on October 15.

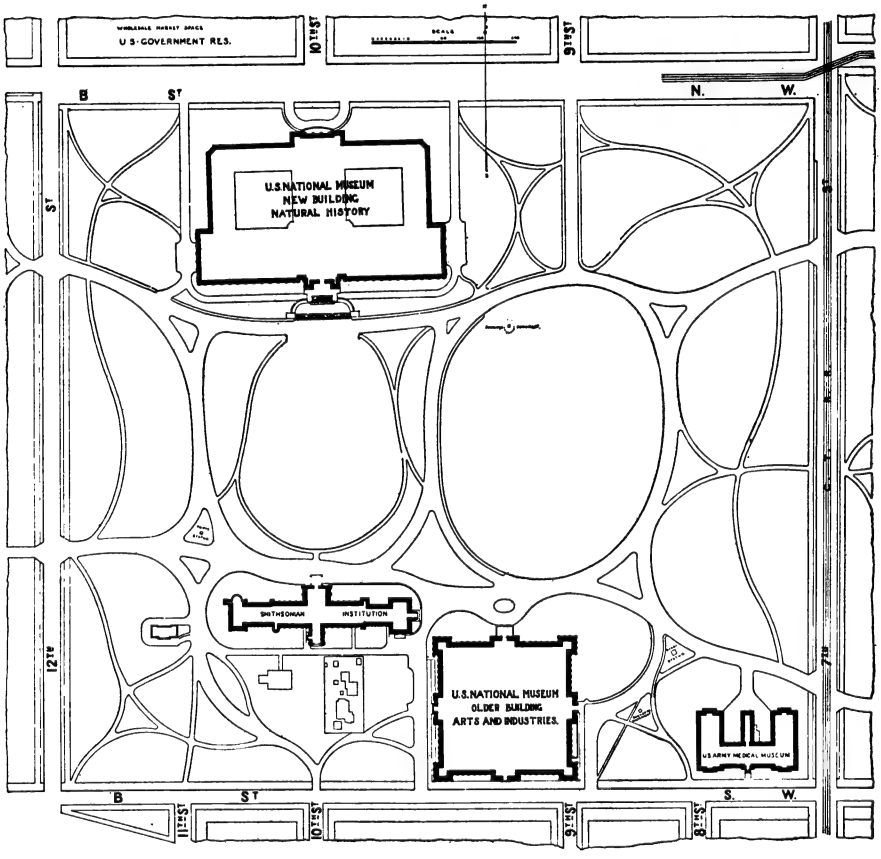
The laying of the extensive granite approaches at the south entrance, commenced in the spring of 1910, and extended into the summer, while the work connected with the finishing of the interior of the south pavilion consumed practically the entire year, ending with the installation of the heavy iron grilles at the entrance on June 20, 1911, just 7 years and 5 days after the ground had been broken.

Certain important matters concerning the building and its surroundings which the original appropriation was inadequate to cover were provided for in the general deficiency act approved June 25, 1910, as follows:

> For the completion of the new building of the United States National Museum and its surroundings, namely, the construction of roads and walks, grading and sodding, construction of a waterproof granolithic platform along the outer walls of the building, and the painting of the interior walls of the building, to be expended under the direction of the Secretary of the Smithsonian Institution, seventy-seven thousand dollars.

The work on the grounds, performed under the direction of the officer in charge of public buildings and grounds, included the readjustment of the main roads where they had been intercepted by the building, and the construction of roads to the entrances and of a continuous water table along the walls, besides extensive grading, sodding and seeding. These improvements, together with the painting of the interior plastered walls and iron work, were completed in the autumn of 1911.

SMITHSONIAN PARK



PLAN OF SMITHSONIAN PARK, SHOWING LOCATION OF ALL BUILDINGS.

While the materials for the building were obtained on contract, the major part of the work connected with its erection was conducted directly by the Government through the employment of labor under the supervision of master mechanics and foremen. A considerable amount of construction work in certain lines, including the materials, was, however, performed under contract, comprising the foundations, the plastering, the roofs in part and the skylights, the stone and concrete floors, the Guastavino tile work, the steam and electrical plant, etc.

The collections of natural history and anthropology destined for the new building had by June 30, 1912, been practically all transferred to the more ample accommodations which it affords, leaving the two older buildings to the occupancy of the departments of arts and industries and American history, except the upper main hall in the Smithsonian building, which has been assigned to the division of plants.

LOCATION OF THE BUILDING

The longest section of the Mall, bounded on the sides by B Street north and B Street south, is that lying between Seventh and Twelfth Streets west. Under the terms of its organic act, the southern half of this square between Ninth and Twelfth Streets was secured to the Smithsonian Institution as a site for its building which was centrally located on this so-called Smithsonian reservation. To the entire square the terms Smithsonian park and Smithsonian grounds have for many years been applied, the latter designation being commonly used in connection with legislative matters. The first of the buildings erected expressly for the National Museum, the brick structure, was placed on the same side of the square but farther south. Beginning about 50 feet from the eastern end of the Smithsonian building, it extends to Ninth Street, the line of which it slightly overlaps. Still farther east, at the corner of B Street south and Seventh Street, is the Army Medical Museum, built a few years later.

As it was important for administrative reasons and for the convenience of the public that the new building should be located near the older ones, and as there was not sufficient space for it in the southern part of the grounds, it became necessary to look to the northern side, no portion of which had yet been occupied. The site chosen is directly in front of the Smithsonian building, the north and south axes of both buildings corresponding with that of Tenth Street extended, and the distance between the two being about 725 feet. While both of these structures face the center of the Mall, the Smithsonian building is parallel with B Street, and the new building parallels the so-called axis of the Mall, a line drawn from the dome of the Capitol to the Washington Monument. As a result, the north

face of the new building is about 25 feet farther from B Street north at the western corner than at the eastern corner, but in view of the length of the front this difference is not noticeable on casual observation. At the middle the distance of the front from the street curb is about 64 feet. The main entrance, facing south, is approached by roads and paths in the Mall, but a secondary public entrance in the center of the north front gives direct access from the street, at a point not far distant from the car lines on Pennsylvania Avenue and Ninth Street.

The ground in this section of the Mall is much lower along the northern edge than in the central and southern part, and at the location of the building the natural slope was somewhat pronounced. In order to obtain the grade established for the building, about 7 feet above that of the adjacent street, it was necessary to do much excavating, amounting to about 9 feet in depth in the southern part of the site but rapidly decreasing toward the north. The grade of the new building is, therefore, considerably below that of the Smithsonian building, but any objectionable effect which this difference might otherwise produce is overcome by the embankment left in front of the south face of the former, reaching well up in the elevation of the basement. On the north side, viewed from any point in the adjoining streets or at a distance, the appearance of the building with respect both to its grade and to its height is pleasing.

GENERAL DESCRIPTION OF THE BUILDING

In the designing of the building two principal objects were kept in view, first, to secure the largest possible amount of available space and, second, to produce a substantial and dignified structure, both of which were satisfactorily accomplished. Planned as a great shell, the better to meet the requirements for exhibition purposes, the building contains few permanent division walls, and by giving exceptional width to the main mass an unusual extent of floor area as compared with the extent of the outer walls has been obtained. Other notable features are the absence of the customary monumental staircase, and the minimizing of dark spaces as also of distracting architectural details in the interior. The construction is entirely fireproof.

The building is four stories high, is exposed and finished on all sides, and occupies a ground area of nearly four acres. In plan, it consists of a large pavilion in conjunction with a rotunda, facing south, from which three wings extend to the east, west and north, the latter in turn being connected near their outer ends by two L-shaped ranges, one on each side, so arranged as to complete the enclosure of two large courts. The outline produced is rectangular

and also symmetrical in that one side of the building exactly duplicates the other. In style, the building is modern classic, showing a strong French influence in having a mansard roof with dormer windows over the ranges.

With the exception of this mansard the outer walls are entirely faced with granite, which in the basement is of a warm gray color, but in all succeeding stories is nearly a pure white. The basement, moreover, has a heavily rusticated façade, which serves as a pedestal member for the upper part of the building on which the surfaces are smooth. The building is simple and imposing, attracting rather by the restraint with which the detail is handled than by any elaborated elegance, and in its main features is strongly suggestive of the purpose for which it was designed. Most noticeable in this respect is the exceptionally large size of the window piercings in all but the upper story.

The pavilion which, in connection with the rotunda, forms the commanding feature of the building, is expressed in the façade by a projection with a portico supported by eight Corinthian columns, a range of six in front with two in a second row flanking the main entrance doorway. The top of the entablature of the portico rises to the level of the top of the attic story of the wings and above this, on each of the four longer sides of the pavilion, which is there octagonal in shape, is a large semicircular window, surmounted by a pediment. Leading to the portico from the driveway in the park is a broad approach of granite steps with intermediate platform.

Above the basement story the pavilion serves as the outer or enclosing shell for the greater part of the rotunda, the space between the two being occupied by galleries built at the levels of the several floors of the wings. The construction of the rotunda comprises four great piers of stone so built and placed on the diagonal axes of the pavilion as to form the shorter sides of an octagonal enclosure, measuring 83 feet 5½ inches across. The longer sides consist of arched and screened openings across which the galleries are thrown, the arches themselves corresponding to the lines of the semicircular windows of the outer shell. The shorter sides grow into pendentives supporting a circular drum which breaks through the roof of the pavilion and is capped by a flat dome.

The wings are of practically the same width as the pavilion. The fronts of the east and west wings in conjunction with that of the pavilion compose the main and southern, as also the longest, exposure of the building. These façades consist of a basement and two stories below the main cornice and an attic. The window openings except in the attic story are much wider than the intervening piers and in the two main stories extend continuously throughout nearly their combined height. The piers which support the cornice have Tuscan

pilasters on their outer faces, and the secondary cornice crowning the attic is carried by smaller pilasters.

The elevation of the ranges, but for the pilasters which are here lacking, is identical with that of the east and west wings, except above the cornice where the stone work is replaced by a slated mansard. The ranges are, therefore, subordinated to the wings as are the wings to the main pavilion.

All of the wings at their outer ends extend somewhat beyond the line of the face of the adjoining ranges. In the case of the north wing, which is mostly enclosed within the mass of the building, the projection forms a secondary pavilion, 122 feet 9¾ inches wide and 23 feet 11 inches deep, with the middle part slightly recessed. This pavilion is treated in a general way like the south front of the wings, but as it is the central feature of the north side of the building and contains another public entrance, here in the basement, it has been worked out somewhat more elaborately, and the pilasters between the large windows of the first and second stories are replaced by engaged Tuscan columns. The projection of the east and west wings, which is 125 feet 2 inches wide, amounts to 30 feet 11 inches.

The heights above grade level of certain prominent structural features are as follows: The floor of the south portico and the top of the water table, 23 feet; the top of the entablature of the portico, 79 feet, and of the pediments on the faces of the south pavilion, 124 feet 9½ inches; the crest of the dome of the rotunda, 165 feet 2¼ inches; the top of the main cornice in the wings and ranges, 65 feet 5 inches, of the stone work in the wings, 81 feet 10½ inches, and of the stone work in the ranges, 71 feet 5 inches; the peak of the roofs in the wings, 96 feet 4 inches, and in the ranges, 85 feet.

The length of the south front of the building in the basement is 561 feet, of the north front, 499 feet 4 inches, and of the east and west sides, 313 feet 2 inches. The projections at the center of the north and south fronts increase the depth of the building to 364 feet 6 inches, to which the approaches add 70 feet 2 inches of stone construction on the north and south axis. Slightly greater length dimensions are furnished by the water table which projects 1 foot, and by the cornice which projects 2 feet 4 inches, beyond the vertical plane of the outer surface of the basement walls. The face of the first and second stories, which is uniform throughout, is set back 1 foot from the face of the basement, and that of the attic story, 4 inches more.

Below the level of the upper cornice of the wings the south pavilion is fundamentally square in plan, and its extreme width, inclusive of its side walls, is 118 feet. The east and west wings, measuring from these walls and including the thickness of their end walls, are each 221 feet 6 inches long, although from the south their

SOUTH FRONT OF BUILDING AND OUTER END OF EAST WING, VIEWED FROM THE SOUTHEAST.

length is made to appear somewhat greater, owing to their façades overlapping the sides of the pavilion where it narrows toward the front projection. This projection, which amounts to 27 feet 5½ inches below and 16 feet 3 inches above the water table, is 80 feet 2 inches wide in the basement and 79 feet 5 inches wide within the portico. The north wing is shorter than the others, its length being 214 feet 7 inches. The arms of the ranges are all of equal length, and measure 188 feet from the wings. Their width over the outer and court walls is 60 feet 10 inches.

The two large uncovered courts enclosed by the wings and ranges are 128 feet 2 inches square in the basement story. Their walls are built of gray-white semi-vitreous brick with belt courses of gray granite, and above the basement, which projects 4 inches, they extend flush to the top of the upper story.

The granite used for the outer walls of the building is of three kinds, namely, the so-called pink or warm gray variety from Milford, Mass., for the basement story, the water table, and the south and north approaches; white granite from Bethel, Vt., for the first and second stories, the main cornice, and all the walls of the south pavilion and rotunda above the basement; and a nearly white granite from Mount Airy, N. C., for the attic story. As a rule the stone is laid in regular horizontal courses, among the few exceptions being the low arches over the basement windows. Above the base course and the course next following it to the water table it is cut with rusticated horizontal and arch stone joints, the raised faces, except the projecting key stone of the window arches, having a picked surface. Otherwise, the surfaces are essentially smooth, being 4-cut in the basement, including the water table; 6-cut for the first and second stories and the south approach; and 4-cut everywhere above the main cornice and the cornice of the south pavilion.

Back of the granite the walls consist of hard-burned red brick, followed by an inner facing of porous hollow brick to provide a damp proof and dry non-heat conducting lining. This construction, which is also followed in the court walls, includes vertical chases, 9 inches wide and 8 inches deep, extending from the foundations to the attic and designed for the vertical distribution of pipes, wires, etc. As a rule, there are two such chases in each of the wall piers between windows.

The roofs of the wings and ranges are relatively low, and such slopes as are visible from the surrounding park and streets, as also the roofs and dome of the main pavilion and rotunda, are covered with a light green slate. The remaining parts of the roofs, aside from the skylights, are copper covered.

In the general absence of interior structural walls, it has been necessary in providing for the support of the wide floors and the roofs to

introduce many interior piers and columns, which are arranged in one or more rows. The former, which are confined to the basement, are of brick; the latter are of steel enclosed in terra cotta. The story heights in the clear are 18 feet for the basement, 20 feet for the first story, 19 feet 6 inches for the second story, and 12 feet for the attic story.

The length each of the east and west wings in the inside is 216 feet 1 inch, and that of the north wing 205 feet 2 inches measured through the middle. All are approximately 116 feet wide. As it would be impossible to light this entire width from the sides a large skylight has been introduced in the roof of each wing, covering the central space in the first story to a width of about 50 feet and a distance of between 167 and 168 feet from the wall of the south pavilion. In this manner are formed three great halls which break through the upper stories and are surrounded by broad aisles on the sides and at the outer end, the line of demarcation being marked by rows of large piers. The floors of the second and third stories and the lofts correspond in position and width with these aisles, being bounded on the inner sides by the walls of the light wells. The basement on the other hand is entirely ceiled over.

Each of the ranges, including both arms, has a total interior length of 316 feet 10 inches, and as the width between walls is only 54 feet 2 inches their lighting is amply provided for by the windows.

The first and second or exhibition stories, except for the few structural walls before mentioned and certain screen walls, have been in no way subdivided, but the basement and third story are extensively partitioned to meet the requirements for the storage and study of collections, the mechanical plant and the work shops. Circulation around each story is continuous and unobstructed.

To permit of uniformity in the installation of cases in the exhibition stories, the wings and ranges have been constructed on a unit basis of length measurement, which is constant throughout. This arrangement, which also lends itself to the room divisions in the other stories, has been facilitated by the uniformly straight horizontal lines of the inner surfaces of the walls. The length of this unit, which is 18½ feet, is the distance from center to center of adjacent wall piers, and also of the interior structural piers and columns in the several rows.

The provision is therefore for a single window in each unit, although in the third story of the wings a granite mullion divides the outer openings into double windows. In the first and second stories the openings have been given a width of 11 feet 6 inches as compared with 7 feet for the width of the intervening piers, and a maximum of glass surface has been secured through the use of light metal framing. The basement openings are 10 feet wide. In the length of the façade of

NORTH AND WEST FRONTS OF BUILDING, VIEWED FROM THE NORTHWEST.

the east and west wings there are on each side of the south pavilion eleven window openings in each story, at the ends of these wings five openings, and in each front of the ranges nine openings. Two of the basement openings at the outer ends of these wings, the second one from each corner, have been carried down to the ground level and made into wagon entrances for freight and coal. The window arrangement in the courts agrees quite closely with that of the outer walls except in the attic story.

The building contains three public stairs of moderate but adequate dimensions, so disposed as to encroach but little upon the floor space. One is located directly east of the north entrance, while the other two occupy tower-like constructions in the northeast and northwest corners of the main pavilion. There are four passenger elevators in two pairs, one of which is on the west of the north entrance, the other in the main pavilion near the south entrance. Two large freight elevators are also provided, being placed one on each side of the building at the junction of the ranges with the wings and in close proximity to the entrances for the delivery of freight. Service stairs adjoining these elevators connect the several stories.

A modern steam and electric plant, installed in the basement of the east wing, provides for the heating and lighting of not only this but also the other buildings occupied by the Museum and furnishes such motive power as is required. The mains are carried through tunnels under the basement floor, whence connections are made with the several stories through the chases in the wall piers. Arrangements likewise exist for ventilation, vacuum cleaning, the manufacture of ice, the distribution of hot and cold water, announcing and fighting fire, watchmen's signals, and for other purposes connected with the maintenance and protection of so large a building with its valuable contents.

An important feature is a well appointed auditorium, with a seating capacity for 565 persons, located in the basement story of the main pavilion.

The ground area covered by the building, being the dimension of the basement story, is 136,171 square feet, while the area enclosed by the building, that is to say the area of the basement and of the courts combined, is 168,752 feet. With the addition of the granite approaches, the space comprised within the area of the building construction is increased to 176,834 square feet.

The total extent of available floor space furnished by the building is 468,118 square feet, distributed as follows: Basement, 121,173 square feet; first story, 119,480 square feet; second story, 86,357 square feet; attic story, 86,428 square feet; the lofts in the wings, 54,680 square feet.

The solid contents of the building amount to 11,604,984 cubic feet, and its cost, including the power plant and other mechanical equipment, was, therefore, at the rate of 30 cents and a small fraction a cubic foot, which is relatively very low for the construction of a building of such a substantial character.

In the detailed description of the building which follows the architectural attic is referred to as the third story, while the lofts are designated collectively as composing the attic story. The term ground story is also employed instead of basement as better denoting the nature and importance of the use of this story, and it is the term which has come to be generally recognized.

EXTERIOR WALLS

FOUNDATIONS AND GRADES

While the grade of the building site with reference to mean low water mark in the Potomac River at Washington is so low as to have practically interdicted the construction of an underground story, but little difficulty was encountered in providing secure foundations without resorting to piling. This was due to the fact that the ground occupied was mainly a natural slope composed of clay, sand and gravel, although on the northern side adjacent to the old Tiber Creek, long since filled in, softer material was found and much deeper excavations were necessary.

The grade level of the ground about the building was fixed at +11, and that of the basement or ground floor at +14, the former being approximately 4 feet and the latter 7 feet above the grade of B Street north, from which the front of the north pavilion is distant about 64 feet. With the natural surface rising toward the south the extent of the excavation for the site increased in that direction, and the south front of the building is faced, beyond a broad area containing a drive, by a sloping bank which reaches a maximum level of +23.92 or a height of about 13 feet above the ground level of the building at the foot of the south approach, leading to the main entrance on the first floor. At the sides of the building the embankments gradually disappear toward the north.

The foundations range in depth from an average of +5 at the south to an average of —2 at the north and an extreme of —8.5 at the northeast corner of the building. They rise to a grade level of +10.5 for the exterior walls and of +12 for the court walls. They are constructed of concrete and consist of stepped footings surmounted, in the case of all exterior and other structural walls, by foundation walls, but the interior brick piers rest directly on footings. The width of the footings and the thickness of the walls vary considerably in accordance with the requirements of the super-

structure. Under the south or main façade the footings are 11 feet wide at the bottom and the walls, 6 feet thick; under the exterior façades of the ranges they measure 9 feet 3 inches and 4 feet 2 inches, respectively, while under the court walls they are considerably narrower. Especially heavy foundations were required for the south pavilion and the outer ends of the east and west wings, where the walls reach an extreme thickness of 7 feet 8 inches.

SOUTH PAVILION AND ROTUNDA

The south pavilion, surmounted by the drum and dome of the rotunda, owes its prominence exteriorly to its height above the main roofs, its projection beyond the general line of the south façade of the building and its more elaborate treatment. If its southern projection be excepted, it is square in plan and about 118 feet across as bounded by its main walls to the height of the adjoining wings by which these walls are concealed on three sides. Above the roofs of the wings, where the walls are entirely exposed, the octagonal shape of the interior is also manifested on the outside, and it presents four broad faces, which are 82 feet 2 inches wide on the east, west and north, and 79 feet wide above the portico entablature on the south. The diagonally disposed faces, which are separated from the others by projections right angular in plan, are much narrower, measuring only 8 feet 3 inches wide in direct elevation and 11 feet ¼ inch wide in normal elevation.

The broad fronts, each of which is pierced by a large semicircular window, are pedimented, with a parapet and central parapet block, the top of which is 101 feet 9½ inches above the level of the portico and first floor, the ridge of the slated roofs behind the pediments being 99 feet 1 inch above the same level. The sides of the faces above the roofs of the wings and above the portico have a raised, pilaster-like projection, 9 feet 9 inches wide, terminating above in an entablature which does not extend across the faces but returns with the pilaster upon the pediment walls, and is continued around the broken walls connecting the faces, these walls, like the pediments, being also surmounted by a parapet. The frieze of this entablature, which is 3 feet 8½ inches wide, is ornamented with an incised Greek fret.

While the east, west and north faces are equidistant from the center of the pavilion, the south face above the first floor level is set out 18 feet 8 inches farther and projects 16 feet 3 inches beyond the general line of the front of the building, not including the pilasters. In a recessed wall in the front of this projection, which is 79 feet 5 inches wide to the height of the two main stories of the wings, is the main entrance to the building, the recess in combination with a

column-supported construction across the entire face forming the elaborately decorated portico described below.

The openings in the masonry for the large semicircular windows have an extreme radius of 20 feet 4 inches to the inner edge of the archivolt. In the jamb and at the sill there is a rebate 11 inches wide, by which the opening is reduced in area to less than that of a semicircle of 19 feet 5 inches radius. The archivolt is 4 feet wide, is divided into 27 voussoirs, and has a sunken panel face and molded inner and outer edges. Each opening is divided by two granite mullions, 3 feet 2 inches wide, into three sections, of which the middle section is slightly wider than the lateral ones at their base. The window area in these sections is subdivided by a lattice pattern into triangular lights. The framework is constructed of sheet copper, reenforced where necessary to provide proper stiffness, and the sills and spaces in the frames are filled with concrete. The glass is plate, ground on the inner surface.

In the ground story, where the south projection amounts to 27 feet 5½ inches and is 80 feet 2 inches wide, the side walls are of the Milford granite, but above the first floor level the stone work is entirely of the Bethel granite, laid in regular courses 2 feet wide except as architectural or decorative features have necessitated a different treatment.

The rotunda construction of the interior is carried through the roofs of the pavilion in the form of a circular drum, 84 feet in diameter, also faced with Bethel granite in 2-foot courses to a height of 1 foot above the ridges of the pediment roofs. The upper 6½ inches of the next course carry the lower member of a 3-foot 5¾-inch metope and triglyph-decorated frieze, which is followed by a denticulated cornice, 4 feet 4½ inches wide. Above the cornice the remaining granite work consists of a capped parapet 4 feet 1⅞ inches high, and three courses of stone aggregating 4 feet 2⅝ inches in height, each of these crowning courses being stepped back to the extent of about its own height on the course below. The top of the upper course is 17 feet ¾ inch above the parapet blocks of the four faces, and 118 feet 10¼ inches above the first floor level.

The slate-covered dome, the construction of which is described in another connection, is a spherical segment 75 feet in diameter at its base and 21 feet 8 inches high above the upper edge of the drum. The top of the curb around the eye at its crest is the highest masonry work of the building, being 142 feet 2¼ inches above the first floor level and 165 feet 2¼ inches above the grade level of the building.

PORTICO

The portico, which is singularly effective and imposing, is in architectural treatment of the Roman Corinthian order, its main features

SOUTH PAVILION, ROTUNDA, PORTICO AND APPROACH.

being two rows of columns supporting an entablature. From their size, excellent proportions and perfection of workmanship, the columns are especially noteworthy. The capitals, patterned after those of the temple of Jupiter Stator in Rome, in their elaborate carving by means of pneumatic tools, show depth and precision of cutting not expected to be obtained in so hard a material as granite, and are striking examples of the possibilities in this direction. The projection of the portico from the wall of the pavilion is 6 feet 1½ inches to the center of the front row of columns, and 9 feet 1¾ inches to the outer side of the plinth blocks of these columns. The middle part of the pavilion face under the portico roof is recessed to a width of 39 feet 1 inch and a depth of 13 feet 2 inches, the inner wall of this recess being pierced for the main entrance door, the opening for which, between the stone masonry, measures 12 feet 9 inches wide by 25 feet 9 inches high.

The floor of the portico is at the same level as the main floor of the building. Except for the 7¾-inch water table projection, it has the same width as the projection of the pavilion, namely, 79 feet 5 inches, which it carries to a distance of 11 feet 10¼ inches, when it becomes abruptly restricted to a width of 67 feet 1½ inches and extends 6 feet 3 inches farther to meet the steps of the south approach, of which it forms the upper landing. It is constructed mainly of the Milford granite, but inside of the inner row of columns and in the three passageways between columns leading into the recess, where the stone is laid in a paneled pattern, a New Jersey granite of a more decided pink color has been used in combination. All other parts of the portico are of the Bethel granite.

There are six columns in the outer row and two in the inner, the latter standing just within the recess, but the motive of two complete rows of six columns is carried out by the introduction of pilasters on the adjacent walls. The height of the columns as also of the pilasters, including plinth blocks, is 45 feet to the under side of the entablature. The bases, inclusive of a paneled plinth or low pedestal, 6 feet ½ inch square, are 3 feet 11 inches high; the shafts, 36 feet 4¾ inches high; and the capitals, 4 feet 8½ inches high. The shafts of the columns measure 4 feet 3 inches in diameter for one-third of their height, and thence diminish in size to a diameter of 3 feet 7¾ inches at the necking. They are divided into six nearly equal parts, while the capitals are cut from two stones, being jointed horizontally at the top of and behind the upper row of acanthus leaves. The intercolumniation varies, the distance from center to center of the columns in the outer row being 15 feet 3 inches at the middle of the portico and successively 13 feet 10½ inches and 13 feet 1½ inches toward the sides. The distance between the plinth bases of the front and inner rows is 2 feet ½ inch.

There are four pilasters on the front wall recalling columns of the outer row, and two on the side recessed walls recalling the columns of the inner row. Four of these, in pairs, adjoin at the exterior angles of the recess, the cap and base moldings and other decoration merging. Except for their width which is uniformly 3 feet 11 inches and the jointing which is the same as that of the walls, the pilasters have the same treatment as the columns.

The entablature is 11 feet high, which brings the total height of the Corinthian order of the portico to 56 feet from the floor level. There is, however, a surmounting parapet wall, 2 feet 5½ inches high, the outer face of which is 5 feet 1½ inches back of the cornice edge. The frieze on the front of the entablature is 73 feet ½ inch long, which is 6 feet 4½ inches less than the width of the pavilion face, while the length of the highly decorated cornice, with an overhang of 4 feet 11¾ inches, exceeds that width by some 3 feet 7 inches. From the portico the entablature, with modified cornice, extends on to the face of the pavilion projection and returns against its side walls.

Surrounding the opening of the main entrance is a decorated architrave 2 feet 1¾ inches wide, while above the architrave is a 3-foot paneled surface separating it from a console-supported cornice 3 feet 11¾ inches wide. A console band 1 foot 2¼ inches wide, down the sides of the opening, further increases the masonry decoration. The only other piercings within the portico are two plain window openings, one above the other, in each side wall of the recess. A base, 3 feet 11 inches high, extends around the walls of the portico. The upper part of the walls back of the caps of the columns and to the height of the same is decorated throughout, except where interrupted by the pilaster caps, with a horizontal paneled band, which is continued on the return walls of the projection. The ceiling of the portico is coffered and the moldings are carved.

SOUTH APPROACH

The south approach which leads to the main entrance presents a broad expanse of stone in harmonious relations with the pavilion and its portico. The construction is entirely of masonry and all exposed parts on top and at the sides are, with few exceptions, of the Milford granite.

There are two runs of steps, an upper one of twelve and a lower one of eight, separated by a platform. Each run is flanked by massive dies of which the longer axis extends north and south in the upper and east and west in the lower. Including the dies, the upper part of the approach is of somewhat less width than the portico, but the lower part is about two and one-half times wider than the upper, the increase occurring in connection with the platform. The grade of

the driveway in front of the lowest step is +23.92, while that of the portico floor, forming the upper step, is +34, making the total rise about 10 feet. The distance in a horizontal line from the edge of the lowest step to the outer edge of the portico floor is 52 feet 5½ inches.

The upper dies measure 12 feet 6 inches deep by 11 feet across and their tops line with the floor of the portico. The distance between them is 45 feet 1½ inches, which is the length of the steps in this series except the lower four which are longer and return against the dies. The lower dies, which are 11 feet deep, 20 feet across the front and 6 feet 7¾ inches high above grade, are 123 feet apart. All of the steps of this run are of that length with the exception of the lower two, which also extend a short distance on to the outer faces of and return against the dies. All steps are 18 inches wide, except the bottom one in each run which is 20 inches. The rise is 5 inches with a wash of ½ inch. The dies, in their shape and position, have been planned to serve as pedestals for sculpture groups, and each is surmounted by a low plinth.

The outer ends of the intervening platform are in plan quadrants of a circle, with an extreme radius of 31 feet 4 inches, swinging outward from the upper to the lower die on each side. Completing and concentric with these curved ends on each side is a massive granite seat or bench, which is raised above the platform level by two steps. These seats, which are cut in several sections each from a single block of stone, stop 6 inches short of the flanking dies and terminate in an arm at each end. The extreme width of the platform, including the seats, is 139 feet 4 inches; while its depth from one run of steps to the other is 22 feet 1½ inches. The platform is laid in a panel design, having across its depth three rows of square panels, separated and bordered by bands of pink New Jersey granite. On each side, in front of the lower curved step leading to the seats, is an ornamented border each alternate stone of which has a perforated design. The perforations, extending entirely through the stones, give outlet for the water from the platform, which is crowned and built to drain toward them. The steps, like the platform, are cut with a rise or crowning surface from the ends to the center, the greatest rise, namely, 3 inches, occurring in the bottom step.

From the outer ends of the platform on each side a finished granite retaining wall preserving the same curvature is carried down to the level of the grade of the basement area. The original plan contemplated a granite retaining wall, surmounted by a balustrade, starting from the lower dies of the approach and facing the southern, eastern and western fronts of the building, but its expense was greater than could be met from the appropriation and in its stead the embankment has been sloped and sodded.

The granite work of the approach is supported and backed by brick masonry, consisting of heavy piers, walls and arches resting on concrete footings. Extending in front of the ground story projection of the pavilion, and therefore partly under the portico and partly under the upper run of steps, is an arched passageway, 12 feet 3 inches wide, faced with white glazed brick and having granite trimmings, which serves to connect the area driveway. On its north side is an entrance into the ground story of the building, and on the opposite side a door opening under the approach. The south wall of this passageway in conjunction with the curved granite walls under the ends of the platform surround the foundation construction, and within this enclosure a considerable space, measuring 134 feet in greatest length by 21 feet in greatest width, is available as a vault for storage purposes.

OUTER WALLS OF THE WINGS AND RANGES

The total height of the stone work composing the south and end faces of the east and west wings is 82 feet 1½ inches, made up of the three kinds of granite in the following proportions, namely, Milford granite, 23 feet 3 inches; Bethel granite, 43 feet 5 inches, and Mount Airy granite, 15 feet 5½ inches. Of the Milford granite 3 inches are below grade, and 3 feet 3 inches are below the ground floor level. The Bethel granite begins at the first floor level and extends 11 inches above the third floor level; while the Mount Airy granite reaches 4 feet 4½ inches above the third story ceiling. The ranges have the same extent of Milford and Bethel granite, but in the third story the use of Mount Airy granite is restricted to a parapet wall and the framing of the dormer window openings.

The height from floor line to floor line in both the wings and ranges is 20 feet for the ground story, 21 feet 6 inches for the first story, and 21 feet for the second story, while the height from the floor line to the ceiling of the third story is 12 feet, making a total of 74 feet 6 inches, or 7 feet 7½ inches less than the entire height of the stone work in the wings.

Ground story.—The base course consists of large stones having a uniform height of 5 feet 7½ inches and exposed to the extent of about 5 feet 4½ inches. The top of this course forms the sill line for all ground story windows, which line is 2 feet 4½ inches above the finished floor level of the interior, except in those parts of the story where, as elsewhere explained, the height of that level has been increased by 3 inches. Between the base course and the water table course there are six regular horizontal courses, the lower being 1 foot 10 inches thick, the four following alternating 2 feet 2⅛ inches and 2 feet 9⅞ inches, and the upper 2 feet 6 inches. Seven voussoirs enter into the composition of each window arch, and between them at the middle of the piers, forming a unit of what is above referred to as the sixth

course, is a single stone. Above the two lower courses to the water table the stone is cut with rusticated horizontal and arch stone joints, the raised faces, except that of the projecting keystone of the arches, having a picked surface. Measured over the raised surfaces only, the four courses above the two lower ones are all approximately of the same width. The water table presents a plain vertical edge 2 feet 3 inches thick.

All granite work is at least 10 inches thick, but courses and individual stones exceed this thickness in varying degree in order to insure proper binding with the brick backing. Stones entering into the construction of window and door jambs, heads, etc., extend back into the reveals far enough to enable the inner edges to be covered by the window and door finish. The reveals, however, do not run through flush the entire thickness of the stone work, being broken by minor reveals. The total thickness of the walls to the outer face of the rustication is 5 feet 4 inches in the wings and 3 feet 8 inches in the ranges.

The typical window openings of the ground story are 10 feet wide and 10 feet 6 inches high to the crown of the low segmental arch. The width of the intervening piers is 8 feet 6 inches. The openings for the wagon doors at the outer ends of the east and west wings have the same width as the windows but are 15 feet 10 inches high from the pavement. The piers at these two ends have an extra brick backing which increases their thickness.

First and second stories.—The granite work of these stories is treated throughout as though for a single story. The combined height of the stories, which begin on top of the water table course and extend to about the middle of the main course of stone of the main cornice, is 42 feet 6 inches. The sill or plinth course of the first story, which is 3 feet 11 inches high (this being also the height of the sill above the floor in the inside of the building), carries around the entire building as a strong horizontal line, and all pilaster bases, plinth blocks, etc., are above it. Below the window openings this height is occupied by two stones, the upper, a sill stone 1 foot high, and the lower, a sub-sill or facia stone. In the east and west wings this lower stone is cut with a slightly raised panel, flanked on either side by simple brackets in low relief. From the sill line the window openings and intervening piers of the wings extend continuously and uniformly to the lower edge of the entablature of which the main cornice is a part, a distance of 31 feet 10 inches. In the ranges, however, the height of these openings is reduced to 31 feet 6 inches by a shallow 4-inch reveal which extends across the openings below the entablature. The division of the window space between the two stories is marked by a galvanized iron panel at the level of the second story floor.

The window openings are 11 feet 6 inches wide, the piers, 7 feet wide. In the wings the piers have pilasters 3 feet 8 inches wide, projecting 13 inches, with their bases, caps and the entablature treated architecturally in the Tuscan style. The thickness of these piers, exclusive of the pilasters, is 3 feet 3 inches. In the ranges the piers have simply 1-inch raised panels on their faces and, excluding these, are 2 feet 8 inches thick. With the exception of a 1-foot 10-inch course immediately above the sill course, all stones between the sill course and the entablature are laid in 2-foot courses. The thickness of the stone is about 1 foot where a greater dimension is not required.

The entablature, which is uniform in design and size throughout its entire length, is 7 feet 8 inches high and its greatest projection is 3 feet 4 inches beyond the face of the two stories below. Of the four courses comprising the construction, the lower one, 3 feet ½ inch high, forms a rather prominent architrave, while the next above, 1 foot 8½ inches high, embodies a relatively unimportant frieze and the bed molding of the modillioned cornice. The modillions are 2 feet wide, occupy an 8⅝-inch course and are spaced about 3 feet 8 inches on centers. The upper and most important stone of the cornice and of the entire entablature is 2 feet 2⅜ inches high.

Third story.—The stone work of the third story of the east and west wings, extending 15 feet 5½ inches above the main cornice, includes a secondary cornice, 2 feet 4 inches high with a projection of 2 feet, and a parapet. In elevation the vertical lines of the first and second stories are recalled with short pilasters, 3 feet wide and 10 inches in relief, having a paneled face, while the piers are 8 feet 1½ inches wide. Each window opening of the main stories is represented in the third story by double openings, 4 feet wide by 6 feet 8 inches high, the companion windows being separated by stone mullions, 2 feet 4½ inches wide. The thickness of the piers is 2 feet 11 inches, but a stone trim around the windows, projecting 4 inches, makes the total reveal 3 feet 3 inches. The top of the stone sill is 1 foot 7 inches above the top of the main cornice and 2 feet 2½ inches above the finished floor level, which is 3½ inches higher than was originally planned, these figures being also the same for the ranges.

In the ranges there is a 5-foot parapet wall between the dormer windows, resting on the main cornice and succeeded by a slate-covered mansard roof. The windows are placed one above each of the larger window openings of the main stories, and measure in the clear 5 feet wide by 7 feet high. The architrave around them carries down to the sill course, and all of the windows have pediment heads, alternating between the square and segmental. The brackets at the sides of the architraves, supporting these pediments, rest upon the parapet wall.

North pavilion.—The north pavilion, formed by the extension of the north wing beyond the face of the ranges, although not attaining the architectural or structural importance of the front of the south pavilion has been treated in a manner consistent with its prominence as containing the secondary entrance to the building. Its projection in the ground story is 23 feet 11 inches and its width 122 feet 9¾ inches (reduced to 121 feet 10 inches in the succeeding stories), the central part to a width of 64 feet 10¼ inches being slightly recessed and divided into three complete 18½-foot bays with a narrow bay on each side. The flanking pavilions at the sides of this recess measure 28 feet 11¾ inches wide.

Other than changes in the detail, the central part of the pavilion in particular conforms closely to the architectural treatment of the east and west wings. The base courses, rusticated lower story, water table and entablature, features common to both the wings and ranges, extend across the entire front. The walls of the flanking pavilions are pierced in the several stories, on both the front and return walls, by relatively small windows, but in the three center bays the large openings characteristic of the wings and ranges are repeated, although in the ground story flat lintel-headed door openings replace the segmental-headed window openings of the other parts of the building. Each of these three entrances, one in each bay, is 15 feet 4⅝ inches high by 8 feet 6 inches wide and is framed in part by a molded architrave. The lintel stones and the outer face of each alternate jamb stone are molded, the intervening stones being prolongations of the picked surface stones from the pier walls.

The window openings of the first and second stories, beginning about 1 foot above the finished first floor level, are 34 feet 9 inches high and 11 feet 6 inches wide. The sill and base courses of the typical wing and range windows are recalled in front of these openings by balustrades, 3 feet 11 inches high, built between the plinths of engaged Tuscan columns which decorate the intervening piers. These columns are 4 feet in diameter below, and 3 feet 6 inches at the necking; the lateral ones are recalled by pilasters against the slightly projecting walls of the minor pavilions. The double windows of the third story are 7 feet 2 inches high by 4 feet 4½ inches wide. The piers are 7 feet 10 inches, and the mullions 1 foot 11 inches, wide. The third story stone work is 16 feet 6 inches high from the top of the main cornice and finishes with an individual cornice and low parapet wall.

The vestibule floor is 1 foot 9 inches above the grade of the driveway leading to the northern entrance. The upper step occurs between the jambs of the three openings and has a 6-inch rise. Outside of the walls there are two risers, the lower 9 the upper 6 inches high. The

latter leads to a platform 65 feet 6 inches wide, and varying in depth from 12 feet 4 inches in the middle to 3 feet 7 inches at the ends, its outer edge being the arc of a circle of large radius. The step below the platform is 18 inches wide and concentric with it.

The total height of the pavilion from the bottom of the outer step of the approach to the top of the parapet wall is 83 feet 2 inches. The walls of the central recessed part are 6 feet 9 inches thick in the ground story, and 2 feet 9 inches thick behind the columns in the second and third stories. The thickness of the front and side walls of the flanking pavilions in the ground story is 3 feet 6 inches and 3 feet 2⅞ inches, respectively.

COURT WALLS

The walls of the two courts are alike, being faced with a gray-white semi-vitreous brick in combination with gray Woodstock granite, having a 4-cut surface. They are backed with red brick the same as the outer walls. The distribution of the granite is as follows: There is a base course 4 feet 3 inches high, exposed to a height of 3 feet 10 inches above the grade of the courts, the top of which forms the sill line for the ground story windows. The arch of these windows has a granite keystone, which is followed by a water table course and a sill course for the first story, the latter measuring 3 feet 11 inches wide, this being also the height of the sill line above the first floor level. Beginning at the level of the top of the second story windows there are four courses of granite, the first serving as lintels, the second and third forming the main cornice, and the fourth the sill course for the third story. Above the third story windows are three courses, forming the lintels, a secondary cornice and a low parapet. All other surfaces are of the light colored brick. The entire height of the walls above grade is 79 feet 10½ inches. In the ground story the thickness of the wall masonry is 2 feet 10 inches; and in the first, second and third stories, 2 feet 6 inches, the walls being recessed to the extent of 4 inches from the water table up.

The width of the typical window openings is the same in all stories, namely 11 feet ¼ inch, the exceptions being presented by a few windows at the junction of walls, with a width of 9 feet 5 inches, and certain still narrower openings into stair towers and wells. The typical piers between openings are 7 feet 5¾ inches wide. The openings of the windows in the ground story are 11 feet 2 inches high, with a low segmental arched head and a minor reveal around the sides and tops of each opening. The granite sill line is 2 feet 3 inches above the floor level in parts of the story and 2 feet 6 inches elsewhere. Four doorways leading into each court from the wings and ranges have the same width and treatment as the windows, the only difference being the extension of the openings to the floor level. There

NORTH PAVILION, SHOWING NORTH ENTRANCE DOORWAYS IN GROUND STORY.

WEST COURT, LOOKING TOWARD THE SOUTH PAVILION AND ROTUNDA, AND SHOWING THE PROJECTION OF ONE OF THE STAIR TOWERS.

is also a small door at the base of each stair tower. As in the outer walls, the window openings for the first and second stories are continuous and have a metal panel at the floor division; they measure 31 feet 6 inches high. A minor reveal on the outside of the wall piers, 1 foot 4¼ inches deep, carries around both sides and over the heads of the windows. The window openings of the third story are 7 feet high.

INTERIOR STRUCTURAL FEATURES AND ROOFS OF THE WINGS AND RANGES

In order to provide the large open spaces contemplated by the general plan, but few interior walls having a structural relation to the building have been introduced in the wings and ranges, nearly all subdivisions being effected by means of subsidiary partitions. Such walls, in fact, occur only between the wings and the ranges, between the wings and the south pavilion, and, in the ground story, between the north vestibule and lobby and between the lobby and the body of the north wing. Within the south pavilion, however, many structural features exist as described elsewhere.

As additional supports for the wide and heavy floors resort has been had to numerous piers and columns of masonry and steel, which are disposed in a single regular row lengthwise through the ranges and in two or more rows through the wings. The steel columns where not actually embedded in walls have a fireproof covering of terra cotta, producing piers, and both these and the masonry piers are finished to correspond with the finish of the walls. In the ranges, where the width is not so great but that the lighting may be entirely obtained from the sides, the successive floors are unbroken, but in the much wider wings it has been necessary to pierce the middle part of the several floors above the first story in order to obtain light from overhead.

Ground story.—The concrete floor base of this story rests directly on the ground and on the top of certain tunnels in which heating and other mains are carried. The finished floor surface was planned to have a uniform grade of +14, but in order to reduce the height of the window sills to a convenient level for the tables in the laboratories, it became necessary to raise the grade generally, though not everywhere, to the extent of 3 inches. The transition from one level to the other at places where the two adjoin has been accomplished by a gradual sloping of the floors.

The great span and weight of the first floor have rendered necessary correspondingly heavy supports which consist of brick piers, except in the north entrance lobby where steel columns have been used. The spacing of the piers in each row conforms, with few

exceptions, to the length unit of measurement of the wings and ranges, namely 18½ feet from center to center, and this arrangement is the same in all stories. These isolated piers stand opposite the piers of the outer and court walls and, therefore, in line to support the girders of the floor above.

In the east and west wings the piers are mostly arranged in three longitudinal rows, the northern row, measuring from centers, being 32 feet 1 inch from the court wall, the southern row 32 feet 5 inches from the outer wall, and the middle row midway between the other two. The middle piers are 3 feet square and the lateral ones 3 feet by 3 feet 9 inches. Toward the outer ends of these wings the arrangement is modified to form two crossrows of four piers each, the piers in the outermost row being larger than all the others, and especially the northern and southern ones which measure 5 feet 3 inches by 4 feet 1½ inches. In the north wing, where the piers all measure 3 feet by 3 feet 9 inches, they are disposed in four rows, leaving the center of the floor unincumbered. Measuring from centers, the two inner rows are 29 feet apart and 11 feet 3 inches from the lateral rows, which, in turn, are distant 32 feet 1 inch from the side walls. The single row of piers through the ranges is distant 17 feet 6 inches from the court walls, leaving the middle part of the floor free for corridors where partition walls have been constructed. The piers measure 3 feet by 3 feet 9 inches, except one at the northeast and one at the northwest corner of the ranges which are 5 feet 3 inches square in their greatest dimension. All of these piers are built of hard-burned red brick and capped with granite blocks or templates as bearings for the floor girders, corresponding templates being also inserted in the side walls. They are mostly plastered, which adds about 1½ inches to the dimensions above given, but in the east wing and the middle of the west wing they are simply painted.

The steel columns in the lobby at the north entrance are of the box type, built up of two 15-inch channels fastened together with 17-inch by ¾-inch plates. There is a row of four, enclosed in marble, extending east and west through the middle of the room, and two others in the north wall of the lobby, one opposite each of the outer columns of the middle row.

First story.—The floor of the first story is coextensive with that of the ground story and is of exceptionally heavy construction. The framework consists of box-type steel girders, 2 feet 10 inches deep by 2 feet 6 inches wide, running, with few exceptions, at right angles to the outer and court walls and resting upon these walls and the granite-capped brick piers below; and of steel I beams, typically 18 inches deep, spanning between the girders. The girders are, as a rule, spaced 18½ feet on centers, while the beams are spaced 5 feet

$3\frac{1}{2}$ inches in the wings and 5 feet 6 inches in the ranges. Tie rods $\frac{7}{8}$ inch in diameter and about 4 feet 6 inches apart are used between all beams. The tops of all girders are $4\frac{1}{2}$ inches below the finished floor level, and their bottoms including the furring of terra cotta blocks project 21 inches below the rough ceiling of the ground story. The spaces between the beams are filled in with segmental brick arch construction, 9 inches thick, and the rough floor is leveled off with concrete to within 5 inches of the finished floor line.

The interior upright supports for the second floor consist entirely of I-shaped steel columns, which are 15 inches over both dimensions and built up of single plates 15 inches wide stiffened with 7-inch by $3\frac{1}{2}$-inch by $\frac{5}{8}$-inch angles, except in certain instances where the plates and angles are slightly lighter or heavier. They are spread at the base and riveted to plates which are in turn riveted to the first floor girders. In the ranges the distribution of these columns is identical with that of the piers in the ground story, but in the wings only the outer rows of ground story piers, one on each side and one at the end, are represented, an exception occurring at the northern end of the north wing, where there are two crossrows of four columns each.

Second story.—While the girders of the second story floor have the same arrangement and spacing as those of the first story, they are of the single plate type, with the middle web 3 feet deep and the top and bottom cover plates 14 inches wide by $\frac{7}{16}$ inch thick. In the wings, however, they occur only between the outer and court walls and the rows of columns, leaving the space included within the columns entirely open, the well through which the middle part of the main story in each wing derives its light from the skylights beginning at this level. The girders with their furring project 2 feet 4 inches below the rough ceiling of the first story. The I beams between the girders, 12 inches deep, are generally spaced 5 feet 7 inches in the wings and 1 inch less in the ranges. The tie rods, $\frac{3}{4}$ inch in diameter, are spaced the same as in the first floor. The floor construction is of terra cotta flooring tile, 12 inches thick, topping 5 inches below the finished floor level.

The steel columns of the second story are identical in construction and position with those of the first story, but differ in a general $\frac{1}{16}$ inch reduction in the thickness of the plates and angles. Those in the wings, however, except the extreme northern crossrow in the north wing, are enclosed in the walls of the light wells, which are partly supported by beams of the same depth as the typical floor beams, attached to the light well side of the columns and 8 inches from them. Similar beams occur at the floor levels of the third and attic stories. The light well partitions are further stiffened in the three stories by double 3-inch by 3-inch by $\frac{3}{8}$-inch angle studs secured to the beams and spaced between the columns.

Third story.—The steel framework and terra cotta construction of the floor in this story is the same as in the second story, except that in the ranges it has been necessary to make provision for the truss struts of the roofs. The rows of columns are also omitted from the ranges as the support of the floor above is provided for in the roof construction, though the two columns, one each at the northeast and northwest angle of the ranges, are continued as partial supports for the trusses of the hip roof at those places.

In the wings the steel columns are disposed as in the first and second stories, and consist generally of a 15 by ⅜-inch plate stiffened with 3 by 4-inch angles. With the exceptions to be noted, these columns stand just outside the walls of the light wells to which their covering of terra cotta and plaster is joined, forming attached piers on the floored side of the story. The two corner columns at the outer ends of the east and west wings, consisting of somewhat heavier plates and angles, are slightly out of alignment with the other columns, and with their coverings stand separate from the light well walls. They bear, however, upon the corresponding larger columns and piers of the lower stories, and serve as supports of roof trusses beyond the line of the interior columns.

Attic story.—Only the wing sections of the attics or lofts are actually floored over, 12-inch I beams spanning between the lower members of the roof trusses and spaced 6 feet 8 inches, carrying the terra cotta floor arches which are of the same thickness as the depth of the beams. As the beams project 1 inch above the terra cotta construction, their lower surface is buried to that extent in the rough ceiling of the third story which is finished flush throughout. The structural columns are attached to the walls of the light wells as in the story below. They are, in fact, prolongations of the third story columns and extend to a height of 10 feet 2 inches above the finished attic floor, furnishing attachment for the inner ends of the lateral sections of the roof trusses, intermediate members of which divide the attic space into cross-sections 18½ feet in length.

The range attics are low, serving as air chambers and used for pipes, ducts, etc., and have been left unfloored except for a 2-inch layer of cement on top of the furring of the third story ceiling.

Roofs.—The roofs of the wings consist of low slopes at the sides and ends, the outer ones being covered with slate, and a flat deck which, together with the court slopes, are covered with copper. The skylight, in the middle of the deck of each wing, has a double pitch. The range roofs above the mansard are flat-decked and copper-covered, sloping toward each side.

Roof framing.—The roof trusses are spaced 18½ feet on centers, in conformity with the length unit of the building. In the wings three trusses are, in fact, used to span the width of 116 feet between the

outer and court walls, one for each of the side spaces and one for the intervening skylight area. For the former, which measure 32 feet 5 inches between the columns and the outer walls and 4 inches less between the columns and the court walls, the trusses are diamond-shaped, resting at the wall ends on cast-iron shoes at a level of 16 inches below the attic floor and riveted at the other ends to the tops of the columns 10 feet 2 inches above the floor. For the intervening space of 51 feet 6 inches the trusses employed are triangular in shape, being riveted to the columns 7 feet above the floor, their apexes reaching a height of 15 feet 4 inches above the same level. The various members of the trusses are built of angle iron riveted together in pairs. The top members of the outer trusses are two 5 by 3½ by ½-inch angles, and the bottom members two 3½ by 3½ by ⅜-inch angles; while in the middle trusses the top members consist of two 6 by 6 by ⅜-inch, and the bottom of two 5 by 3 by ⅜-inch angles. All columns are braced at the top by 15-inch I beams extending between them, and in other ways the entire framework is secured and reinforced in a manner to obtain the necessary rigidity.

On top of the triangular trusses is a raised platform or deck of 9-inch I beams and 3 by 2½-inch angles designed to support the skylight construction over the central part of each wing. A line of these beams extends continuously above the apexes of the trusses, and another line 8 feet from the first on each side of the ridge, while the angle curb construction carries the lower edges or eaves of the skylights.

Projecting 9 feet 9 inches into the lighting space on all sides is a series of 12-inch beams, which are framed into the columns at one end and suspended from the trusses at the other, the outer ends being connected and the construction thus stiffened by 12-inch channels. Riveted to the channels and suspended from the trusses by angles, 8-inch I beams, spaced 18½ feet, span the 32 feet from channel to channel, the approximate width of the skylight, and this framework, with some subordinate members, carries the ceiling light construction which is described in another connection.

At the northern end of the north wing, in the space between the stair well and the elevator shaft, 12-inch I beams are used instead of trusses as roof supports, and the floor construction of the third story in this section, therefore, differs somewhat from that at the outer ends of the east and west wings. Here I beams carry the weight of the floor arches directly to the outer walls instead of indirectly performing that function through the trusses as is typical elsewhere.

All roof truss members in the side and end sections of the wings which are not protected within the roof and floor construction are enclosed in expanded metal jackets and fireproofed with a casing of lime plaster gauged with cement.

In the ranges the typical roof trusses have a span of 52 feet 2 inches in the clear. The lower member is 2 inches above the third story ceiling line, from which level to the apex of the truss the height is 7 feet $\frac{3}{4}$ inch, this being the maximum height of the range attics. The outside ends of all trusses rest upon built-up struts having a 10 by $\frac{3}{8}$-inch plate stiffened by four $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{5}{16}$-inch angles and bearing upon the third story girders inside the walls of that story. The inside ends of all typical trusses bear directly upon cast-iron shoes bolted to the top of the court walls. The top and bottom members of the typical trusses are formed of double 6 by 4 by $\frac{7}{16}$-inch angles riveted together. The interior members are of lighter material, as are also certain special trusses at the northeast and northwest corners of the building, which do not completely span the ranges but have an intermediate bearing in the single interior column at each of these points. The trusses are stiffened by latticed purlins extending at right angles to them and spaced 12 feet 6 inches on centers, and these spaces in turn are traversed by beams, 4 inches deep, spaced 6 feet 2 inches on centers, which are riveted to the purlins. The bottoms of the purlins are $6\frac{1}{2}$ inches, and of the beams 2 inches, above the third story ceiling, the metal lathing of which is fastened to the beams and lower members of the trusses.

Roof shell and covering.—The construction to which the outside covering of slate is attached, on the mansards of the ranges and the outer slopes of the wings, consists of a 5-inch shell of reenforced cinder concrete supported between I beam purlins at the upper edge and the wall at the lower. Elsewhere, except where skylights occur, the construction is a combination of concrete frames and terra cotta arches covered with copper, built in the following manner: Reenforced concrete rafters, 4 inches wide, spaced 16 inches on centers, and having intermediate points of support in the I beam purlins of the steel framework, run in a transverse direction across the roof. The spaces between the rafters are filled with terra cotta blocks, but as the entire construction is flush and the materials were placed in the one operation the result is a continuous slab or shell reenforced by the rafters. The usual thickness of this construction is 6 inches, but over wide spans blocks 10 inches thick and rafters of the same depth occur. Embedded in the concrete work of alternate rafters, and therefore on lines 2 feet 8 inches apart, are galvanized iron wires in the form of loops, the ends of which project sufficiently above the concrete to fasten small galvanized iron T's running with the rafters and standing about $2\frac{1}{2}$ inches above them. The entire surface is furthermore topped off with a 1-inch coating of cement mortar which covers all wires and the lower flanges of the T's, leaving the upright arm of the latter projecting. The sheet copper, which is of 12-ounce weight, is laid on this surface and the parallel standing joints follow

and are secured to the ribs or projections of the T's, being locked, folded over and riveted with copper rivets and burrs, no solder being used. The cross-joints, which have a uniform spacing of about 8 feet, are locked and soldered. The ends of the standing joints at the gutters are capped and the copper is soldered to the gutter lining. All gutters are formed of concrete and lined with 14-ounce copper, having soldered joints between the individual sheets, and soldered at the outer edge into a raglet cut in the granite parapet. The cresting which tops the slate work on the wings and ranges is of 16-ounce copper.

The slate is of a light gray-green color and came from Poultney, Vermont. It measures generally 20 inches by 12 inches by ⅜ inch, is laid about 8½ inches to the weather, and is nailed to the cinder concrete. The copper cresting comes down over the upper courses and at the gutters the lining is flashed up under the lower edge.

Skylights.—The skylights covering the middle sections of the wings are 32 feet 2 inches wide; in the east and west wings they measure 149 feet 4 inches long, while in the north wing the length is 6½ inches greater. They are double pitched, and their framework rests on and is riveted to the three lines of 9-inch I beams and the angle curb construction already described. The curb walls, of concrete, are 14 inches high, while the end walls, due to the increased pitch of the skylights over that of the roofs, are about 4 feet 6 inches high at the ridge. Centered over each roof truss and extending entirely across the skylights is a walk of reenforced concrete, 2 feet 6 inches wide, covered with copper. The spaces intervening between these solid bands are divided into glazed panels, each 2 feet wide with two lengths of glass to each slope, butt-jointed in the middle.

Under each of the ribs separating the glazed panels and also against the angles of the walk construction is a 1¾ by 2-inch iron channel. These channels are bolted to the curb angles and to the ridge and intermediate beams, and serve the double purpose of providing the necessary stiffness for the glazed surface and of acting as drains from the ridge to the eaves to carry off any leakage or condensation. Within each of the channels, bolted to and extending its entire length, is an inverted wedge-shaped channel of thin sheet metal, 2 inches high, the top surface of which is about 1½ inches wide and provides bearing for the abutting edges of the ¼-inch ribbed wire glass. Above the glass is a sheet copper cap secured to the inverted channel every 2 feet by bolts which pass through the joint between the glass of adjacent panels and, by tightening, hold the glass, which is set in elastic cement, rigidly in place. A thin gasket of sheet lead inserted under the edges of the copper cap where it bears on the glass provides extra security against leakage. Cross-gutters under the skylight at the ridge, intermediate joint and eaves

lead into the channels. All exposed metal with the exception of the lead gaskets is sheet copper.

Against the outer end of each of the large skylights there is an opening, 18 feet 10 inches long by 3 feet wide, covered with a wire screen, which serves as an exhaust outlet for the ventilating fans in the attic.

At the inner end of each of the wings, against the rotunda wall, there is a skylight 38 feet long by 4 feet 6 inches wide, which gives light to the bottom part of the large semicircular windows, and smaller skylights also occur over all the elevator shafts. These skylights correspond in detail of construction with the larger ones.

INTERIOR OF THE SOUTH PAVILION AND THE ROTUNDA

GROUND STORY AND AUDITORIUM

General plan of story.—As before explained, the south pavilion to the height of the adjoining wings is fundamentally square in plan and about 118 feet across, including its enclosing walls which, in the ground story, are 3 feet 7½ inches thick on the east and west sides. The structural features which produce the interior octagonal shape are extensions of the walls of the stair towers at the two northern corners, and walls across the southern corners, behind which are several small rooms and shafts, including the shaft for the south passenger elevators. The projection on the south side of the pavilion in the ground story comprises heavy structural walls designed to support the portico and enclosing two larger and two smaller rooms besides a passage to the driveway under the south approach.

In building the substructure for the large piers of the rotunda, it was found possible to provide for a convenient and commodious auditorium in what would otherwise have been practically waste space, but in so doing it was necessary to extend a part of the floor to a level considerably below that of the ground story. The auditorium occupies the central part of the area, being surrounded by the substructure piers and intervening screen walls, all of which are of concrete. The piers, which are four in number, center on the diagonal lines of the pavilion. They have a maximum width of about 40 feet 6 inches and a maximum thickness of about 10 feet, the width across their inner faces being about 36 feet. From the level of the ground floor to within 2 feet of the first floor level they are of hollow construction, having walls 3 feet thick surrounding irregular shaped spaces, in which diaphragms are built at the level of the spring of the auditorium dome, except those in the southern half of the northern piers which are left open for ventilating purposes.

The line of the outer wall surface of the above construction conforms quite closely to that of the interior of the pavilion, the intervening space, generally 12 feet 6 inches wide, forming a corridor entirely around the auditorium, with large openings into the three wings and the southern driveway, and access to the tower stairs and elevators. With its longitudinal axis corresponding with the north and south axis of the building, the doorways of the auditorium have been placed on the northern side, nearest the public entrance in the ground story, while the speakers' platform is on the southern side. Two brick partitions with large openings, one on each side just south of the tower stairs, separate the northern part of the surrounding corridor from the remainder, and the former has been finished as a lobby to the auditorium. Metal doors in the openings serve to complete the isolation of the lobby, the auditorium entrances and the tower stairs from the east and west wings.

Auditorium.—The auditorium is essentially circular in outline and 79 feet 6 inches in diameter, with short sections of straight wall, about 26 feet wide, forming shallow niches or panels on the east, west and north, and a deep recess on the south. The projection of this recess is enclosed by a curved brick wall having an opening into a small square room which is also reached by means of a door and steps from the southern part of the corridor. The wall surface of the auditorium is further broken by two small niches on the south side, one on each diagonal, and two openings in corresponding positions on the north side, which latter, with a doorway midway between them and opposite the platform, give the means of public access to the room.

Beginning at a grade level of +6.75 in front of the speakers' platform, the auditorium floor rises to +14, the level of the ground floor, at the rear of the room, and affords opportunity for successively higher rows of seats from all of which the platform is plainly in view. The rising floor covers in greater part an air chamber connected with the ventilating system. Dwarf brick, radially disposed walls, built upon the floor of this chamber, support the reenforced concrete slab or base of the dished floor. On this slab concentrically formed steps also of concrete, 2 feet 10 inches wide, have been constructed to carry the chairs. These steps, of which there are eighteen, the lower one 8 feet 8 inches from the platform, vary in rise from 1 inch for the lower to 9 inches for the upper, the level of which is +14.75. Access to the steps or chairs is by means of four inclined aisles, two of which lead directly from the side doors toward the platform, while the others follow the curvature of the side walls of the room. The entire floor is finished in terrazzo pavement.

The covering of the auditorium is a low flat ellipsoidal Guastavino tile dome, which springs from the four concrete piers; it does not

thrust against the intervening screen walls, but the stress is carried by four large penetrations. The tile construction begins 6 feet 9 inches above the finished ground floor level, and the spring line of the dome proper 3 inches higher. This domical ceiling has at the center a circular eye or ring of ornamental terra cotta, 26 feet 4 inches in diameter to the center of a decorative leaf band, projecting sufficiently below the ceiling to allow for the placing of electric lights around the inner and outer edges, hidden from sight behind the molded members. All finished Guastavino tile has a highly glazed ribbed surface and all, with the exception of several courses around the eye, is laid herringbone. The terra cotta matches the tile in color and finish, having a glazed surface, and has the leaf bands and other ornamentation picked out in color. Besides giving a finish for the auditorium, the dome actually supports the floor of the rotunda above, dwarf walls intervening in the space between the two, which at the highest point of the dome is but 18 inches. The dome is designed to sustain a uniformly distributed load of 500 pounds to a square foot. The alcove of the speakers' platform is also finished with Guastavino tile, beginning at the same level as in the body of the auditorium.

Besides the four large elliptical penetrations intersecting the dome from the sides of the auditorium, and having ornamented terra cotta arches against the walls, there are also four smaller penetrations on the diagonal axes over the small niches and corresponding entrance doors. The soffits of the east, west and north arches are 2 feet 2 inches wide and decorated with a fret motive enclosed in a sunken bordered panel, while the soffit of the arch over the speakers' platform is 3 feet 6 inches wide and decorated with rosette-centered panels. The crown of all four of these arches is 15 feet 4 inches above the grade of the finished ground floor, and the arch ring in all cases is 9 inches wide and decorated with a sunken panel and leaf motive. A circular vent register opening is provided in the soffit of each of the large penetrations.

Between the base and the tile and terra cotta work the walls are plastered and finished with a molded cap which carries level around the room except across the niches where the cap is omitted. A 3-inch sub-base of terrazzo extends around the entire room. The base, of Keene's cement, is 15 inches high in the alcove at the south, and continues of the same dimension on a line in front of the platform up to the large niches on either side of the room. In the back of these niches its top line is stepped toward the rear of the room to keep above the level of the inclined floor, finally finishing with a height of 9 inches, or 12 inches above the floor, in the back of the auditorium. The reveals of the plastered door openings are refined by shallow panels.

AUDITORIUM, IN GROUND STORY OF THE SOUTH PAVILION, LOOKING TOWARD THE PLATFORM.

The speakers' platform is 2 feet 6 inches high above the lowest level of the auditorium floor, and 4 feet 9 inches below the floor level at the entrances. It occupies the entire space of the alcove, and has a curved outer edge projecting beyond the area of the alcove, which is struck from the same center as the steps forming the seating planes in the bowl of the room. The floor of the platform is supported on the surrounding walls and intermediate concrete piers with concrete beams, carrying an overlying 4-inch slab of reinforced concrete to which wood sleepers are secured. The final finish of the floor, of the face of the platform and of the steps on both sides is of cabinet oak.

The space under the platform is used as a ventilating chamber, the air having access to the room through 12 cast-iron registers, measuring 14 by 20 inches, in the face of the platform rise. The admission of air from the chamber under the seating part of the auditorium is by means of holes through the floor of the several steps. These holes are about 5 inches long by 1½ inches wide and are spaced to occur under the standards or side supports of the individual chairs except those on the four lower steps to which the chamber does not extend.

The combined surface of the several steps furnishes space for 565 chairs, which are solidly attached to the floor by means of expansion bolts, and, in order to obtain a compact arrangement from aisle to aisle, the chairs have been made of two widths, 20½ inches and 22 inches. The seats are of the usual folding type, 16 inches high, equipped with wire hat holders, and the width of the intervening space between their front edges and the backs of the chairs in the next row is 17 inches. There is a single standard between each two adjoining chairs which provides support for the seats and backs on both sides. Including the supports for the wood-covered arm rests, the standards are entirely of metal; in the base of each is a small register-faced box, a unit of the large system of such boxes, placed over the floor openings to receive and disseminate the air from the ventilating chamber. The seats and backs are upholstered in brown Spanish leather and are built on and furnished with wood frames, all exposed parts of which are of birch stained in imitation of walnut.

The complete isolation of the auditorium, surrounded as it is by two sets of walls, makes it necessary to depend wholly upon artificial means for its lighting. As already mentioned, provision has been made for two rows of concealed electric lamps around the circular eye in the dome of the ceiling, and another row is hidden behind the inside ring of the arch between the auditorium and the alcove of the speakers' platform. Each of the former contains 80 and the latter 23 lamps. In view of their positions and surroundings, the illumination of the room as a whole is reflected and diffused.

The openings of the three entrance doors are 6 feet wide by 10 feet high and have semicircular heads. Two of the doors are opposite the tower stairs, while the middle one centers on the north and south axis of the building. The doors are of walnut, in two leaves, each with a single panel and circular glazed peephole with thin cover disk. They are 7 feet high, the upper part of the openings being filled in with a double-paneled walnut transom. The jambs are also of walnut, but the trims are of plaster with marble plinths. The space directly inside of the middle door has been assigned to the projection lantern.

Auditorium lobby.—The architectural treatment of the auditorium lobby, which is 12 feet 3⅜ inches wide, consists principally of pilasters 2 feet 6 inches wide spaced equidistant at the sides of the entrances to the auditorium, two on each side of the middle door and one on each side of the diagonally placed doors, the same being repeated on the opposite wall of the lobby. With the exception of the door architraves, which are of Keene's cement, and the floor bases, the walls of the lobby are entirely finished in plaster. The spaces between the pilasters where not occupied by door or stair openings are paneled. The pilaster faces are also paneled and finish in a cap the lines of which carry around the lobby as a cornice. The openings from the lobby to the tower stairs are 13 feet 3½ inches wide by 11 feet 1½ inches high, and have paneled jambs and soffits and plaster brackets in the jambs.

The ceiling, beginning immediately above the cornice, is arched with glazed Guastavino ribbed tile, and the highest level of the soffit of this arch is about 6 feet below the first floor level of the rotunda, the space between the false ceiling and the floor construction being utilized for ventilating purposes. Arches or ribs carrying the lines of the pilasters across the ceiling from side to side divide the latter into panels, in which the tiles are laid herringbone pattern.

The wall, door reveal and pilaster bases are of pink Tennessee marble and 12 inches high. The floor is mainly finished in terrazzo, but the pilaster lines are recalled by border lines of pink Tennessee and Sienna marbles enclosing panels of terrazzo. Border courses of the pink Tennessee marble also occur against the walls. The door openings at the two ends of the lobby are of the same shape and size as those of the entrances to the auditorium, but instead of having a transom at the top the double doors occupy the entire opening. These doors are of paneled steel.

PAVILION AND ROTUNDA ABOVE THE GROUND STORY

General account.—The octagonal shape presented by the interior of the pavilion in the ground story continues to the height of the top of the attic story. The interior floor dimensions of the pavilion

are 111 feet 7 inches on the main axes and 122 feet 1 inch on the diagonal axes, the enclosing walls on the east, west and north being 3 feet 3¾ inches thick. The sides of the octagon against the three wings and on the south are longer than the diagonal sides in the proportion of about three to two, and consist of straight walls with openings into the wings and into the south projection. On each side of the portico recess in this projection there is a room about 15 feet square in each story, the intervening narrow space being occupied by the entrance vestibule to the height of two stories, flanked by two very small rooms in both, and a single long room in the third story.

Most prominent in the composition of the rotunda, which also presents an octagonal shape with four sides longer than the others, are four great masonry piers centering on the diagonal axes and placed, therefore, one in front each of the stair towers and of the two opposite shorter walls of the pavilion. These piers extend to a height of 62 feet 5 inches, are 6 feet 10½ inches thick in the middle and 7 feet 6¾ inches thick at the sides, and have an extreme width of 34 feet. In the four spaces intervening between the piers, which are 38 feet wide, are decorative screens composed of three tiers of columns, corresponding to the first, second and third stories, each tier surmounted by an entablature. The screens are on the longer sides of the octagon, the dimension of which is greater than that of the screens alone, since the inner faces of the piers are deflected at the sides at such an angle that parts of their faces parallel the lines of adjoining screens. The length of the longer sides so formed is 47 feet, while that of the shorter sides, entirely included within the faces of the piers, is 16 feet 5½ inches.

The diameter of the rotunda is 83 feet 5½ inches measured diagonally between the faces of opposite piers, and 81 feet 6 inches on the main axes between the faces of opposite columns in the screens. Between the rotunda and the pavilion walls, that is to say back of the piers and screens, there is a passageway or corridor 12 feet 4¾ inches wide, which extends entirely around the rotunda and above the first story takes the form of a gallery at each successive floor level.

Springing from the piers at their tops and spanning the interspaces are four semicircular masonry arches, each having a span of 41 feet 6 inches (being set back 21 inches from the extreme sides of the piers), a soffit width of 7 feet 6 inches and an arch ring width of 2 feet 9 inches. Resting upon the piers and corbelled between the arches are brick pendentives 4 feet 5¾ inches thick at the base and struck from a sphere whose radius is 43 feet 7½ inches and whose center is on a line with their bearing. When the top of the arches is reached a pendentive ring 71 feet 10 inches in diameter, with

varying thickness of masonry due to the perpendicular inside face of the wall, is presented, and upon this the drum masonry bears.

Immediately above the great arches and the pendentives is a plaster entablature, 9 feet 11¼ inches high, followed by a Guastavino tile dome ceiling which is described farther on. The entablature comprises a plain molded architrave 2 feet 10¾ inches high, a frieze decorated with triglyphs and shields in the metopes, 3 feet 5¼ inches high, and a cornice ornamented with dentils and eggs and darts, 3 feet 7¼ inches high and projecting 2 feet 8¼ inches beyond the lower face of the architrave, on which face the inside diameter of the rotunda is approximately 71 feet.

A variety of material is represented in the interior finish of the pavilion and rotunda. The floors, wall bases, plinths and column shafts are of marble of several kinds. Nearly all other stone work is of light gray Bedford, Indiana, limestone with a fine rubbed surface, comprising the inner faces and sides of the piers and a slight return on the back, the paneled jambs of piercings through the piers, the large arches springing from the piers, and the stone work of the semicircular windows and of the screens between and surmounting the tiers of columns. Other than the above essentially all surfaces below the tiled dome ceiling are finished with lime plaster, except the door architraves, jambs and heads, which are of Keene's cement. The plaster and cement surfaces of both walls and ceilings are painted an ivory tint which harmonizes with the color of the limestone.

The piers, the backing or core of which, constituting the structural element, is of hard-burned red brick, have a molded base 7 feet 9¼ inches high and are capped with a 9-foot entablature. The top of the denticulated and bracketed cornice of this entablature is 2 feet 7½ inches above the fourth story level, and following it is a pedestal band 3 feet 5½ inches high, from which spring the four arches entering into the dome construction. Although the arches are of greater span than the width in the clear between the piers, the latter are so designed that the arch is a continuation of the sharply defined break made necessary by the paralleling of the sides to the common axis. This architectural effect is maintained throughout the entire height of the piers, the base, entablature and pedestal returning into the sides against a small projection from the main part of the piers, 1 foot 9 inches deep by 3 feet 5¼ inches wide, which terminates at the top with two inverted consoles occupying the space in front of the pedestal band. These projections are on the screen side of the bearings of the arches, and the combined depth of two of them occurring on each longer side of the rotunda, namely, 3 feet 6 inches, is the difference between the width of each screen space and the span of the arches. The stone courses of the piers necessarily vary so as to carry

INTERIOR OF THE SOUTH PAVILION AND ROTUNDA TO THE HEIGHT OF THE TOP OF THE GREAT ARCHES, SHOWING THE SCREEN, WALLS, AND CLEARSTORY WINDOW ON THE EAST SIDE, AND PARTS OF THE ADJOINING STONE PIERS.

through certain lines of decorative features but are generally 17 inches high.

In the first and second stories each pier is pierced by a heavily architraved opening. The lower openings are 7 feet 9 inches wide by 14 feet 7½ inches high and have console-decorated heads supporting balconies with stone balustrades at the second floor level. The openings in the second story are 6 feet 3 inches wide by 12 feet 10$\frac{3}{16}$ inches high and also have console-decorated heads which support square-headed pediments. As these piercings are through the center of the piers they open upon the rotunda from the diagonal points of the compass and emphasize and make prominent the entrances to the stair towers and elevators.

Each of the great arches consists of 27 voussoirs which are anchored into the pendentive brickwork by means of wrought iron anchors. The soffits of the arches are coffered and have a series of 13 nearly square panels.

The screens between the piers are identical in composition. Each contains four columns in each of the three tiers, which, in the direct elevation of the screens, are centered one over the other through the successive stories. The columns are unfluted monoliths of breccia stazzima marble, 2 feet in diameter in their lower part, with limestone bases and caps. The two middle columns are spaced 11 feet 8 inches on centers, while each of these is spaced 10 feet 6 inches from the outer columns, between which and the sides of the piers only narrow openings occur. The column treatment is recalled against these sides by fluted limestone pilasters.

The architectural order used in the decoration of the first story tiers is the mutulary Doric, the columns, including a 22-inch roseal marble plinth or pedestal base, being 17 feet 4¼ inches high to the under side of the entablature. The bases and caps of the columns, together with certain moldings in the architrave and in the mutulary cornice of the 4-foot ¾-inch entablature, have carved surfaces. The second and third story orders are the Roman Ionic, both alike in appearance but differing in the height of corresponding units. The second story columns, including the 13½-inch height of a plinth course, are 15 feet 2 inches high, and the entablature, the top of which is 12 inches below the third floor level, is 4 feet 1 inch high. The columns of the third story are 11 feet 9¼ inches high, excluding the plinth course which is below the floor level, and the entablature is 3 feet ¼ inch high, projecting 12 inches higher than the fourth floor level. The architraves of the upper entablatures are free from carving, but in the denticulated cornices certain moldings have carved surfaces and of course the Ionic column caps are carved.

Each screen is topped just above the fourth floor level by a limestone balustrade, 2 feet 3½ inches high, with die blocks or pedestals

centered over the columns. Between the columns in the second and third stories are gallery railings of ornamental cast iron, 2 feet 6 inches high, and standards of harmonizing detail are provided in the narrow openings between the outer columns and the pilasters. These railings and standards are secured to a limestone base which brings their extreme height to 3 feet 6 inches and 3 feet 1 inch for the second and third stories, respectively. The railings closing the middle bays in the second story have a center wreath design surrounding an eagle, the balance of the design on either side comprising leaf scrolls. Except for the center, which elsewhere represents a budding growth, all of the other railings are similar in design to those described, and both sides of all railings and standards are finished alike.

Aside from the location, size and design of certain doors, the space back of the piers and screens in the first, second and third stories is almost identical in treatment and finish. In all stories there are low relief panel-faced pilasters, 2 feet 10 inches wide in the first and second stories and 2 feet 6 inches wide in the third story, which occur in pairs near each intersection of the outer or pavilion walls of the octagonal-shaped enclosed space and are repeated on the pier walls. The intersections of these walls are not such, however, in the true geometrical meaning, since the two converging walls are joined by a curved wall struck from a center and of greater arc than those of the opposite pier walls, which are also curved. Recalling the pilasters, metal-furred plaster beams divide the ceiling area into a series of cornice-bordered panels, rectangular in shape behind each pier and screen and triangular at the intersections. Where the screens occur the lower members of these cornices are of limestone, but otherwise the entire treatment is of plaster. The detail of cornices and beams is not elaborate. The beam soffits in the first and second stories have a sunken fret design, while those in the third story have a rosette-centered sunken panel. Slightly projecting mutules with decorated under sides are the only decoration other than the plain moldings on the first story cornices, but in the second and third stories several prominent moldings have some form of leaf decoration.

Through the center of the curved wall surfaces openings occur in all stories, two leading into each wing on the east, west and north sides, and two into the rooms flanking the portico on the south. The first and second story openings are 13 feet high and 6 feet 4¾ inches wide, while those in the third story are 10 feet 6 inches high by 6 feet 8 inches wide. In the second and third stories these are the only means of direct access from the pavilion to the wings, but in the first story an additional opening into each wing, 14 feet 5 inches high by 9 feet ⅝ inches wide, is provided on the common axis of the pavilion, and above it, in the second story, is a balcony opening into

each light well, 13 feet high by 5 feet wide. On the south side of the first story an opening 16 feet high by 10 feet 11 inches wide frames the entrance vestibule construction. The openings of the stair towers are 13 feet 4½ inches wide in all stories, and 16 feet 1 inch, 14 feet 4¼ inches, and 10 feet 5 inches high in the first, second and third stories, respectively. They have paneled jambs and heads. The elevator openings in the southeast diagonal wall, two on each landing, are 7 feet high and 3 feet wide.

As in general plan so in detail a radical change occurs in the fourth story from what may be called the typical finish of the stories below. Pilasters 2 feet 10 inches wide and of relatively large projection occupy corresponding positions to those in the lower stories, but the 10-foot distance between each pilaster and the opposite one across the corridor is spanned by a semicircular metal-furred plaster arch instead of a flat beam. These arches have a stilt of 6 inches above their bearing on the pilaster caps, the members of which are continuous and 6 feet 4 inches high around all walls of the gallery except where the screens occur. The spaces between the pilasters on the diagonal walls are ceiled with low elliptical groined vaults, while the larger spaces between the screens and the semicircular clearstory windows have octagonal coffered barrel vaults over them. On the south, due to the projection of the story over the portico, the vaulted area is somewhat deeper than on the other sides. These vaults are of 21 feet 7 inches radius, and like the rest of the fourth story ceiling finish are applied to a false construction of metal furring.

The walls of the small triangular barrel-vaulted spaces at the intersections of adjacent walls are pierced by 8-foot 9-inch by 5-foot semicircular-headed door openings into the loft spaces of the east, west and north wings and into two small rooms on the south. One of these rooms, the eastern, is occupied by an iron stairway leading to the space above the fourth story ceiling, from which access is had to the elevator machinery and the dome. The elevator openings are semicircular-headed and measure 8 feet 9 inches high by 3 feet wide.

The radius of the clearstory windows, the exterior and general features of which have already been described, is 19 feet 4 inches to the inside line of a molded limestone archivolt, 17 inches wide and consequently having a radius of 20 feet 9 inches, the same as that of the great stone arches. A 9-inch band of these arches, exposed around the coffered vaults, is recalled by a limestone band of similar depth around the window archivolts. The two mullions of the windows have roseal marble paneled limestone faces on the interior, 3 feet 4 inches wide.

Floor construction and finish.—The floor of the rotunda inside of the piers and screens is supported by the Guastavino dome construc-

tion of the auditorium in the ground story. In the corridor, however, steel beams are used, having both bearings on walls except over the openings to the stair towers where a lintel support is provided. The construction for the galleries is the same except that in the screened interspaces the inner ends of the beams are sustained by plate girders 2 feet 2 inches deep by 12 inches wide, spanning between the piers. In the first story the beams are 15 inches deep and in the other stories 12 inches deep, the foundation floor construction in all stories being of terra cotta blocks.

The finished first floor of the rotunda and corridor consists of roseal Tennessee marble, with border lines and inserts of green serpentine and cipollino. A star-shaped center motive of the roseal has a circular border of bands of the same materials. There is a continuous border of the three stones around the rotunda, passing just inside the bases of the piers; a border panel occurs between the bases of the columns, and there are border lines through the corridor with cipollino inserts at each angle of the turns. The floors of the galleries are of pink Tennessee marble with borders of Sienna marble. All of the floor tiles have a fine sand-rubbed surface.

The wall bases, plinths for door trims, etc., match the floor material in the several stories and consist, therefore, of the roseal marble in the first story and of the pink marble elsewhere, finished with a high putty polish. Their height in the first story is 22 inches, in the second story 12 inches, in the third story 9 inches, and in the fourth story, where they are 2½ inches thick and have a molded top, 12 inches.

Main entrance gates and vestibule.—The south or main entrance, leading into the pavilion from the portico, comprehends a single large opening in the granite front, 12 feet 9 inches wide by 25 feet 9 inches high, in which, however, the clear space is reduced by a transom above and 9-inch cast-iron frames at the sides to a width of 11 feet 3 inches and a height of 17 feet 6 inches. This opening is provided with iron gates made in two leaves, which slide on an overhead track supported on a 15-inch channel and a floor guide rail into a pocket in each jamb. The gates are framed by bars of wrought iron, but all detail and ornamentation are of cast iron, and the finish is the same on both sides. Each leaf is divided into three large circular, square-framed, rosette panels with smaller panels between, the entire composition being surrounded with a leaf motive border. The transom bar or band is of a fret design and the transom, which is of a rosette-centered scroll design, is bordered with a leaf band similar to that in the gates. The transom bar conceals the track and track hanger for the gates, which weigh approximately 11,488 pounds and are operated by hydraulic power.

Immediately within the gates is a vestibule of bronze, marble and plate glass construction, mostly confined between the end walls of the

rooms at the sides of the entrance, but projecting slightly into the interior of the pavilion. Its general interior dimensions are, width 11 feet 4 inches, depth 5 feet 7 inches, height 9 feet 8 inches. There are double openings in the front and back, separated in both cases by a central bronze mullion. Each of these openings is provided with double push doors of plate glass framed with bronze, the leaves of which are 2 feet 6 inches wide, their height being 7 feet. The remaining height is occupied by a transom with its bar and by an ornamental cornice at the top. Each door has a 1-inch bronze push bar 3 feet 6 inches above the floor. The sides of the vestibule are of marble paneled in bronze frames, with bronze register faces at the top and bottom. The ceiling, framed by a bronze cornice, is glazed with ground wire plate glass, divided into panels by bronze sash bars.

Above the outer pair of doors and behind the iron gates and transom, extending the full height and width of the masonry opening, is a bronze framework carrying ground plate glass in eight lights across the width and three in the height. On the inner side above the vestibule there is a ground plate glazed area, divided into eight vertical lights by bronze muntins, occupying the remaining height of the 16-foot opening. The glass has an etched ornament around each light.

Other doors.—The doors and trims of the small rooms on the south side of the pavilion are of oak. In the first and second stories the doors of the side rooms are double, and above them are two panels in fixed frames, followed by a transom bar and glazed transom, with a latticed wood grille in front of the glass. The two intervening doors are single, with glass transoms, and this detail applies also to the third story, in which, however, the larger side doors are similar in treatment to the corresponding metal doors leading into the wings. In the fourth story the doors of the side rooms are single.

Of the openings between the wings and the pavilion only those in the third and fourth stories are provided with doors, all of which are of molded and pressed steel, in double leaves and paneled, and have been introduced mainly to serve as fire checks. In the third story the doors are 7 feet 8 inches high, the upper part of the 10-foot 6-inch opening being occupied by transom panels, also in two leaves and hinged to open. In the semicircular-headed openings of the fourth story the doors are of the full height of the openings. The trims are also of steel.

Pediment roofs.—On the east, west and north sides of the pavilion the pediment roofs over the galleries of the interior are supported on 9-inch I beams, both ends of which bear on masonry walls. On the south side, in view of the much greater width of the space between the drum and the pediment wall, it has been necessary to introduce an intermediate truss which spans a distance of 43 feet and bears

upon the ends of a wall corresponding in relative position to the other three pediment walls. The beams from the truss to the drum and pendentive masonry, a distance of 14 feet 3 inches, are 10 inches deep, and those from the truss to the outer wall, a distance of 16 feet 2 inches, are 12 inches deep. Saddles with valley beams 18 inches deep occur on the diagonal lines between the roof slopes. The framework is overlaid with an 8-inch slab of reenforced concrete, and this in turn is covered with slate of the same quality and color as has been used on the wings and ranges.

ROTUNDA DOMES

The covering of the rotunda consists of an inner and an outer dome of Guastavino construction, the former constituting the ceiling, the latter the roof of this part of the building. Both of these domes rest, independently of each other, on the brick masonry of the drum which is entirely concealed from view. The drum begins on a line with the top of the large limestone arches, 85 feet 11 inches above the floor level of the rotunda, where it has an inside diameter of 71 feet 10 inches and is 6 feet 10 inches thick. Retaining these dimensions for a height of 8 feet 3 inches, it then becomes abruptly recessed on the inside and reduced in thickness to 3 feet 9 inches, which is never exceeded above except where certain courses of stone project beyond the general outside surface of the drum. The total height of the brickwork of the drum is 30 feet 3⅝ inches, the outer stone facing passing above its summit to the extent of only one narrow course.

The inner or ceiling dome rests at its edge upon a corbel from the inner angle at the top of the basal or thicker part of the drum, back of the main cornice, a tension ring being provided around the bearing of the shell. Two rows of buttresses 6 inches wide, spaced 10 feet on centers, also brace the dome from the drum. In shape, the dome is a spherical segment, the sphere from which it is derived having a radius of 35 feet 11 inches, and the center being 5 feet below the spring line of the dome. It falls somewhat short, therefore, of being a complete hemisphere, and its diameter at the base is 71 feet 6 inches.

In construction the inner dome consists of three courses of Guastavino tile in thickness, the inner course, laid in herringbone pattern, presenting a buff-colored unglazed surface as a ceiling. At the center there is a circular opening or eye for admitting light, 18 feet 10 inches in diameter, the edge of the shell bearing against a steel compression ring and the opening being finished on the under side with a terra cotta molded ring. The ceiling light covering the eye is concentric with the dome, but derived from a sphere of slightly greater radius. It is divided into a number of component lights by twenty-four ¼-inch by 3-inch radial bars and seven concentric

intersecting rings of the same size metal, all being surrounded by, and the radial bars secured to, an outer ring of ½-inch by 8-inch metal. All of these structural bars are enclosed within and support sheet copper muntins, which are so molded as to provide bearing shoulders for the hammered wire plate glass with which the ceiling light is glazed.

The ledge around the outer side of the base of the inner dome, resulting from the reduction in the thickness of the masonry of the drum, affords a continuous walk, about 3 feet wide, around this part of the rotunda. It is reached from below by iron stairs leading to masonry steps through the drum on the south side, while two doorways through the drum above the northeast and northwest diagonal sides of the rotunda give access to the pediment roofs. There are also eight openings from the walk through the lower part of the dome, leading to the space back of the main cornice in the interior of the rotunda, for convenience in reaching the electrical installation.

The outer dome is of heavier construction than the inner one, consists partly of a double shell, and the curvature of its two surfaces is not the same throughout. The main shell, which is continuous and furnishes the entire inner surface, springs from the upper corbelled part of the brickwork of the drum on a line 116 feet 2⅝ inches above the rotunda floor level. It is 73 feet 11 inches in diameter across its base on the inside, and has a tension ring 14 inches by ⅞ inch around its bearing. It is five courses of tile in thickness, but its curvature in section is not produced from a common center. Around the base on the outside an extra shell, 3 courses of tile thick, is added to produce and complete the proper curvature of the outer surface of the dome, which, as in the case of the inner dome, is a spherical segment, the sphere having a radius of 41 feet 8 inches, and its center being 18 feet 10 inches below the bearing of the shell. This radius is increased about 2½ inches by the slate covering. The extra shell is free from the main shell at the base but gradually merges with it. There is a copper-lined gutter extending around the entire upper dome at its base, being partly cut in the top granite course and partly formed along the under edge of the slate covering. It is given proper fall to downspouts which occur at intervals of 29 feet and are cut through the shell into the space between the domes.

In the crown of the outer dome is an eye identical in size with that of the inner dome and fitted with a similar angle compression ring. Around the eye there is a curb of brick, faced on the outer side and above with molded slate courses, which are in turn covered with tinned sheet copper. The height of the curb above the slate covering of the dome is 19 inches, and its greatest thickness is 20 inches. The skylight over the eye is of a different design and construction from the ceiling light of the inner dome, being slightly conical while the

latter is domical. The radial bars, of which there are twenty, consisting of 3 by ¼-inch wrought iron, extend from the curb around the eye, where they are bolted to cast-iron seats embedded in concrete, to a 3½ by ⅜-inch ring of 18 inches diameter in the center. About 2 feet 3 inches below this ring and attached to it by five 2 by ¼-inch uprights is another ring of the same diameter, from which ½-inch tie or truss rods, placed one under each of the radial bars, extend and are bolted to the outer or curb end of each corresponding bar. By this means added rigidity is given to the skylight frame, which is glazed with hammered wire plate glass in a manner similar to that of the large skylights in the wings. Over the center of the skylight is a sheet copper ventilator 19 inches in diameter.

The outer covering of the upper dome consists of the same light green slate that is used on the main roofs, cut in the so-called fish scale pattern, and laid in 43 courses. While all the slate in each course is of the same size, the size varies in successive courses, from about 2 feet by 3 feet below to about 7 by 13 inches above, and there is also a difference in the thickness, which ranges from 1 inch to ½ inch. Of the length a little more than one-third is exposed to the weather.

NORTH ENTRANCE, VESTIBULE AND LOBBY

The three large doorways of the north entrance, located in the ground story of the north pavilion, open into a vestibule which is adjoined by a capacious lobby providing direct means of access to all parts of the building from this side. These two compartments are separated by a structural wall pierced by three openings directly opposite the outer ones and of about the same width. Each of the six openings is furnished with double glazed doors, and the outer ones are further protected by outside double-leaf iron grilles. All of the doors and grilles are pivoted and constructed to open outward.

Vestibule.—The vestibule is 51 feet 9 inches long, 14 feet 9 inches wide and 20 feet high. Its floor level is 1 foot 6 inches below that of the lobby which is reached by three runs of three steps each, each run being located in front of one of the inner door openings and the several runs being separated by two relatively large square dies, with a narrow die at each end of the series. With the exception of the ceiling and the doors and their trims, the entire room is finished in Tennessee marble. The walls above the base, which is 2 feet 6 inches high, are of a gray variety, laid in ashlar courses 16 inches wide, and have a coarse sand-rubbed surface. The wall base, steps, dies and floor tile are of the pink variety, with a hone finish. The floor tile of the field measure 2 feet 9 inches by 1 foot 2 inches, and the entire field has border courses of the same material. The steps and dies are solid and the former have molded faces.

NORTH ENTRANCE LOBBY, LOOKING WEST.

The doors communicating with the vestibule are on the right, the entrance into the central hall is on the left, and the door opening into the west range is in the center background.

The upper 3 feet in the height of the vestibule is occupied by a plaster cornice and ceiling, some of the moldings of which are decorated. The lower members of the cornice extend unbroken around the entire compartment, but the upper moldings, combining with the members of the beams, extend across the ceiling, dividing it into panels. Centered with each of the three door openings is a large square panel subdivided to an octagonal design and having a rosette center decoration. The spaces intervening between the large panels are occupied by a single shallow rectangular panel.

Lobby.—The lobby occupies the entire width of 116 feet 2 inches of the north wing, from the main part of which it is separated by a structural wall having a central opening, 8 feet 6 inches wide by 13 feet 2¾ inches high, giving access to the middle hall. In the northeast corner, in a recessed pavilion, is the landing of one of the principal stairs, but otherwise the walls are essentially straight, the width of the room in front of the vestibule being 35 feet 5 inches, and elsewhere 37 feet. A doorway at each end leads into the adjoining range, and also communicating with the lobby are two passenger elevators, a stairway leading to the elevator pit and an office room, all directly west of the vestibule; a battery room between the vestibule and main stairway, and a watchmen's room at the southeast corner.

Extending east and west through the center of the middle part of the lobby is a row of four white Vermont marble piers enclosing the structural steel columns elsewhere described, of which each of the middle ones is distant 9 feet 3 inches and the outer ones 25 feet 9 inches from the north and south axis of the room. The two end piers, including the thickness of a pilaster 19¼ inches wide on each face, are 2 feet 1¼ inches square. A marble column stands directly in front of both the north and south faces, and the treatment of the piers is recalled by corresponding pilasters and columns on the opposite north and south walls and a pilaster on both the east and west walls. The middle piers are double, measuring 2 feet 1¼ inches by 4 feet 5⅝ inches. They have a single pilaster on the narrow sides and two on the broader sides, which latter are repeated on the north and south walls. There is also a pilaster on each end wall in a line with the wall between the vestibule and the lobby. The piers and the wall pilasters are jointed, but the shafts of the columns are monoliths and have molded caps and bases of solid pieces. All of the wall surfaces of the middle part of the room between the pilasters with columns, including two large panels on either side of the entrance to the middle hall, are of the same white marble, as are also the architraves of all door openings. The stone has a putty polish finish. The walls at both ends of the lobby are finished in plaster.

The wall bases, the architrave plinths of all door openings and the base blocks under the columns and pilasters are of pink Tennessee marble, 12 inches high, with a hone finish. The floor is of the same material and finish. The field is constructed of tiles averaging about 12½ by 25 inches in size, but is divided into a number of sections by bordered panels carrying the lines of the bases of the piers, and extending between the piers themselves and from them to the corresponding pilasters and columns on the four walls.

The cornice and ceiling finish, as in the vestibule, is entirely in plaster but practically devoid of ornamental moldings or bands. Where the double piers occur the treatment is recalled in the ceiling by the presence of double plaster beams, the soffits of which line with the surrounding wall cornice, and which span the distance between the piers and the corresponding pilasters on the north and south walls. This treatment is repeated in single instead of double form between all other detached piers or columns and their corresponding pilasters. In all respects the cornice members of these beams conform to those of the surrounding walls, thus dividing the entire ceiling into a number of panels. The end portions of the room are treated with a slightly projecting cornice terminating at the ceiling in a cove. In the central part of the room the cornice carries the same lower moldings but, instead of finishing with a cove, it has additional molded members which give a slightly more elaborate effect.

Outer door grilles.—The openings in the masonry of the pavilion front are 8 feet 6 inches wide by 15 feet 4⅝ inches high, but the size of the movable gate area is reduced to 6 feet by 11 feet. The gates, which are of heavy cast-iron grille work, are in two leaves, each 3 feet wide, designed in five panels with a border band enclosing the whole and similar bands between the panels. The space above the gates is occupied by a grille transom conforming in part to the detail of the gate design, with the addition of a conventionalized bison's head in the middle. Grille borders 10 inches wide and a rope motive trim or architrave occupy the space between the gates and the masonry jambs, and this border also carries across the tops of the gates as a transom bar. All gates are supported at the top and bottom on cone-bearing pivots. The free edge of both leaves of each pair has heavy bronze top and bottom bolts countersunk in the stile, so that either leaf may first be closed and secured for the operation of a Yale prison lock placed within one of the ornamental rosettes of each leaf. Each gate is provided with a lever handle on each side, the two being joined together but not operating any locking mechanism. The thresholds are of bronze, ½ inch thick, with vertical cross ribs 1 inch deep underneath and spaced not more than 2 feet apart; they have a scoriated surface.

Vestibule and lobby doors.—All main doors of the vestibule and lobby inside of the grilles are identical in material and design, consisting mainly of plate glass set in molded bronze, of which the frames, trims, push bars, etc., are also constructed. They are in pairs, occupying the three outer and three inner openings, and the two entrances to the ranges at the ends of the lobby. Although the actual size of each pair of doors is but 9 feet 5 inches high by 5 feet wide, all are located in openings of a much larger area. In all cases, except the two range openings which are 9 feet wide, the width between the finished jambs is 8 feet 6 inches, but, while the openings into the lobby from the vestibule and ranges are 13 feet and 13 feet 3 inches high, respectively, those into the vestibule from the outside are 15 feet 4⅝ inches high. The spaces resulting around the actual door openings are occupied by glazed screens, providing lights on either side, and a transom above divided into three lights by the continuation of the mullions framing the doors. The outside vestibule screens are placed 6 inches from the inside face of the stone jambs and are separated from the grilles by 11½ inches. Those of the inside of the vestibule are built flush with the inside face of the wall, as are also the range screens with the range side of the openings. The glass is left clear in the doors and screens of the vestibule, but is ground on one side in those leading into the ranges. All doors are provided with checking spring hinges and stops, and have top and bottom bolts and Yale paracentric locks. The four doors to small rooms off the lobby are of cabinet oak and not glazed.

PARTITION WALLS AND INTERIOR FINISH

LIGHT WELLS AND CEILING LIGHTS

The light wells which occur over the middle section of the main halls in the three wings pierce the second, third and attic stories. They are all of the same design, entirely walled in, and have a ceiling light about 18 inches below the level of the attic floor. Their position and extent are indicated by the arrangement of the rows of piers in the first story, by which their walls are mainly supported. In width they are spaced equidistant between the outer and court walls, but in each case the pavilion wall forms the enclosing wall at one end, while the far wall is distant from the end of the wing 48 feet 6¾ inches in the east and west wings, and 36 feet 11¼ inches in the north wing. The width is identical in all the wells, being 49 feet 4½ inches between the finished wall surfaces, but while in the east and west wings the length is 167 feet 1¼ inches, in the north wing it is 6½ inches greater. The height of the wells from the level of the first story ceiling to the lower side of the ceiling light is 34 feet 8 inches.

In the second story the side and outer end walls have a total thickness of 2 feet but are hollow, being built of 3-inch terra cotta blocks in two shells, which are tied together at intervals by cross-walls of the same material and also enclose the steel columns. The inside shell rests upon the floor construction, but the outer one is supported on auxiliary 12-inch I beams, level with the floor beams and riveted on the light well side to the columns of the first story. In the two succeeding stories the walls, also of terra cotta, are in a single shell 4 inches and 3½ inches thick, respectively, the columns, enclosed in attached piers of 3-inch terra cotta, projecting on the floored side of the walls.

The enclosing walls in the second story, including those of the pavilion, are pierced by balcony openings 5 feet wide by 13 feet high, overlooking the hall below. These openings extend to the floor and are provided with railings 3 feet high, of simple design, constructed of wrought and cast iron, which project 6¼ inches beyond the wall line of the light well and are supported on its lower cornice. There are three such openings on each side of each well, symmetrically disposed, and one at each end, except in the east wing where the eastern wall was left intact to receive a large decorative painting. The wall spaces between the openings are molded, each having one panel, large or small, dependent on the size of the intervening area.

Extending entirely around the lower edge of the light wells is a cornice of plain molded members, 3 feet 10¼ inches high. Its top lines with the second floor level; its lower edge with the bottom of the exposed plaster beams of the first story ceiling, resting, like them, on the molded caps of the hall piers. This cornice is carried upon steel furring and false work attached to the floor construction, and has a cast-iron shelf throughout its entire length. Near the third floor level there is another and more important cornice or rather entablature, since it embodies an architrave of plain molded members, a frieze of Greek fret design and a cornice proper having ornamental moldings. It is 5 feet 10 inches high and, like the lower cornice, is supported on metal false work. Directly above this cornice and converging toward the center of the space is a cove 8 feet high, divided into a series of panels by molded bands over each 18½-foot unit of the building and terminating against a plaster beam forming an enclosing frame for the ceiling lights. The soffit of this beam is 52 feet 4 inches above the first floor level; the length of the area enclosed by it is 149 feet 4 inches in the east and west wings and 7½ inches greater in the north wing, the width in all being 31 feet 3½ inches.

Although the third and attic stories are pierced by the light wells, they open upon an unfinished space intervening between the ceiling lights and the skylights.

CENTRAL HALL, EAST WING, FIRST STORY.

Showing light well with balcony openings, part of ceiling light, and the screen walls between the piers on each side. The painting "Diana of the Tides" is on the distant wall of the light well. Exhibition of fossil vertebrates.

The ceiling lights are identical in design and construction in the three wells. The glass area, which is of the same width in all, namely, 29 feet 3½ inches, is 147 feet 4 inches long in the east and west wings and 147 feet 11½ inches long in the north wing. All are composed of panels of ¼-inch wired plate glass, longitudinally ribbed on the under surface, measuring 1 foot 5¼ inches by 5 feet 5½ inches and set in T-shaped wrought iron sash bars. The primary framing of the lights as a whole consists of 15-inch channels around the outer edge, and of 8-inch I beams running transversely and longitudinally across and along the lights. These give attachment to a framework of light steel bars supporting the sash bars, and the entire framework is suspended from the roof trusses of the skylights. The longitudinal beams are embedded in the plaster work of beams which project slightly from the under side of the light, and separate the central portion of the light from glazed border bands, 4 feet 4 inches wide, along the sides. The transverse beams occur above the longitudinal ones and have suspended from them plaster beams similar to the above, forming dividing lines across the light at intervals of 18 feet 6 inches. The ceiling lights are reached from the upper side by means of wood walks for cleaning and repair.

SUBDIVISION OF THE STORIES

Plan of subdivision.—The ground and third stories have been extensively subdivided into compartments for laboratories, the storage of specimens, shops, offices, etc., and some simple partitions have been built in the lofts, but in the first and second stories the principal constructions of a subsidiary nature besides those enclosing the light wells are certain screen walls introduced to subserve the purposes of public installation. The enclosures of the elevator shafts and stair wells in the north wing and the ranges, however, are all built to a greater or less extent of terra cotta, though in all cases but one they are partly bounded by structural walls, the same conditions being repeated in all stories, and in the first and second stories terra cotta screens enclose the space between the stair well and the elevators in the north pavilion.

The subdivision of the ground and third stories has been based upon a uniform plan, which comprehends the utilization of nearly all the window lighted space for working purposes and consequently the placing of the corridors as far as possible or as far as was expedient from the outer and court walls. The typical arrangement contemplated a corridor through the middle of each range and one around the middle part of each wing, adjoining the light wells in the third story and the dark area occupied by the piers in the ground story. While the typical plan has been carried out with little deviation in

the third story, it has been subjected to marked changes in the ground story, owing mainly to the fact that the latter has been adapted to a greater variety of purposes. The corridors are generally 10 feet wide, but in places their width is much greater, especially at the outer ends of the wings and at elevator and stair landings.

The spaces between the corridors and the outer and court walls, subdivided by cross partitions into rooms, vary in width for the most part to the extent of only a few feet, but in some places these prevailing dimensions are greatly exceeded. The cross partitions are spaced almost entirely on the basis of the 18½-foot length unit, which, except in the case of certain closets, toilets, etc., has been the smallest dimension recognized in the subdivision. Nearly all rooms of greater size than this are multiples of the unit as regards length, and since the cross partitions start at the middle of the piers between windows the arrangement insures a full window space for each unit and renders feasible any future subdivision of the larger rooms on the same basis. In furtherance of this plan a door opening has also been provided in the corridor or corresponding partition opposite each window, and, with few exceptions, communicating doors between rooms occur in the cross partitions, being placed in a line throughout each corridor section, and, so far as possible, in positions to permit of the economical installation of standard furniture. The corridor openings generally are 3 feet 6 inches wide, but the communicating doorways and those leading into toilet and housekeeping rooms are only 3 feet wide as a rule. The customary height of the openings is 7 feet.

Ground story.—The partition walls in the ground story are almost entirely of brick and 9 inches thick, but in a few connections terra cotta has been used. The subdivision of the east range is typical. The piers are on the court side of the corridor, being detached from the corridor wall in the northern section, but in the eastern section the wall is built between the piers near their inner edges. The room spaces enclosed between the corridor and the outer and court walls vary in width in different sections from 18 feet 1 inch to 23 feet 11 inches. The length divisions within these enclosures average large, ranging up to six units which is the greatest length dimension in the building under similar conditions.

In the west range the corridor has been omitted, but the space on the court side of the range has been enclosed by a continuous partition in the same manner as the corresponding part of the east range, and the enclosed area has also been subdivided into rooms. Otherwise the range has been left entirely open except for a small room adjoining the north entrance lobby, a small compartment built at the northwest corner of the range, and a vestibule at the entrance into the west wing, in front of the freight elevator and service stairs.

The north wing between the north lobby and the south pavilion contains two lengthwise partitions built in sections between the piers of the outer rows and joining them near their outer edges. The greater part of each pier, therefore, projects on the central space or hall, which also contains two other rows of identical but detached piers. The central hall is 147 feet 2½ inches long and 52 feet 11 inches wide, while the side enclosures are 30 feet 5 inches wide. The latter contain the main comfort and toilet rooms and other compartments.

The subdivision of the west wing closely follows the typical plan. The middle part of the wing has been enclosed in a large but subdivided compartment, the walls of which are built between the piers of the outer rows excluding the crossrow at the extreme west and the easternmost pier of the northern row. These walls extend from the floor to the ceiling without transoms or other openings than those for the doors, of which there is one in each 18½-foot unit on the north and south sides. The piers between which the walls are built stand mostly within the enclosure, but project to the extent of 4¾ inches on the outside of the walls. The compartment is divided lengthwise through the middle by a continuous wall of macite, and again by two cross partitions of the same material into four subcompartments of unequal size, designed for the storage of alcoholic specimens.

Corridors on the north and south sides of the central compartment separate it from the window-lighted spaces along the outer and court walls, which are subdivided into rooms, with door openings opposite those of the large compartment. These corridors are enclosed at their outer ends by walls provided with double doors. There is a locker and toilet room in the northeast corner of the wing, and two large rooms in the northwest and southwest corners, at the sides of the inner driveway with which they communicate as well as with the body of the wing.

In the east wing, the entire southern side, to a maximum width of 33 feet 6 inches, has been separated from the remainder of the wing by successive partitions built between the piers of the southern row, and partly provided above with large fixed glass transoms or borrowed lights. The space so enclosed along the south front is subdivided into three large and two small rooms, all of which, except one of the latter used for toilet purposes, are equipped as construction and repair shops, and have large communicating openings, 8 feet wide by 10 feet high, fitted with fireproof doors of special design. The long partition bounds on the south the space occupied by the steam and electrical plant, which is entirely open at the western end. The boiler room is enclosed on three sides and a partition extends along the north side of the engine room. Separated from the latter by a corridor is a series of small rooms facing the court

and built in accordance with the typical plan, which are used as machine shops, etc. A large compartment at the northeast corner of the wing serves as a coal bunker, and another large room has been formed by walling off about two-thirds of the width of the space originally included in the inner driveway.

In order to light the corridors their walls are mostly provided with transoms, which also occur in certain other long walls opposite windows. Typically, each 18½-foot unit or bay of these walls contains a rectangular opening, 13 feet 9 inches long, which begins 11 feet above the floor and has a height of 4 feet 8 inches. These light units are divided by steel mullions into five equal windows with double sash, the lower stationary, the upper hung on chains and weights so that it can be entirely lowered. The frames, which are set in the middle of the 9-inch walls, the sash, trims, etc., are of molded pressed steel; the glass, of which there is an area of 36⅔ square feet in each unit, is clear plate, wired, and ¼ inch thick. This arrangement has been followed in the two ranges, in the north wing, and in the north and south walls of the lengthwise corridors of the west wing. In the north wing the openings have plaster molded sills, but elsewhere they are flush all around. The transom lights in the east wing and in a few other isolated positions are of simpler construction.

First and second stories.—In the east and west wings of the first story the central skylighted parts of the great halls have been screened from the aisles at the sides by plain plastered walls of the entire height of the story, which are built between the piers of the lateral rows except in the outer interspace at both ends of each of these rows. In the east hall these walls are of brick and 10 inches thick, but in the west hall they are of macite reenforced with steel rods and 4½ inches thick.

In the central hall of the north wing, where the walls were built for hanging pictures, the construction is quite different, consisting of a reenforced macite core covered on both sides with wood, which in turn is covered with burlap. The area comprised within the screening extends to the crossrow of piers at the north, and the walls return at both ends so as wholly to enclose the space except for the entrances, of which there is one at each end. The walls are only 13 feet 11 inches high, leaving an opening of 3 feet between their top and the under surface of the ceiling girders which span the piers. The enclosure is subdivided by partitions of the same height and character as the outer walls into eight rooms with three short corridors.

The space between the stairs and elevator shaft at the extreme northern end of the north wing is enclosed in front by a hollow wall of terra cotta, 23 inches thick, which encloses four structural columns

and is pierced opposite the large windows with three large openings. This construction is repeated in the second story, where the walls are 21½ inches thick and contain five openings. In this story, moreover, the side walls of the light well also carry through to the above described wall, each having a large opening.

Besides the above, the only other walls of a subsidiary character in these two stories are those of the light wells, the elevator shafts and adjoining small rooms, and the stair wells, already referred to.

Third story.—The width of the ranges, measuring 54 feet 2 inches in the other stories, is in this story reduced to 51 feet 10 inches by a furring of 3-inch terra cotta blocks built in front of the sloping mansards in order to obtain straight vertical walls between the windows, which are deeply recessed. This furring occupies a width of 13 feet 1¾ inches in each interspace between windows, and the spaces enclosed by it contain the steel columns or struts supporting the outer ends of the roof trusses. Additional terra cotta furring, 8 inches thick, is built against the structural wall around the windows for the purpose of giving greater outside reveal to the latter and of providing space in the jambs for the weight boxes.

The typical plan of subdivision has been closely adhered to in the third story except on the north side of the west wing, where the entire space between the light well and the court wall has been left undivided. The corridors extend through the middle of each range and around three sides of each light well in the wings, the second gallery in the rotunda furnishing passageway on the fourth side and serving as a means of communication between the wings. The corridors have a uniform width of 10 feet except at the north end of the north wing and at the juncture of the ranges with the east and west wings, where they are wider. The spaces between the corridors and the outer and court walls vary in width from 19 feet 7 inches to 22 feet 8½ inches, except at the outer ends of the east and west wings, where they are 37 feet 9½ inches wide, and at the northern end of the north wing, where they are only 16 feet 9½ inches wide. The subdivisions or rooms formed by cross partitions in these window-lighted spaces are generally of the dimensions of one and two units, in two cases reaching three units and in a third four units. A few exceptions occur, as in connection with the toilets and certain small rooms used for closets and other purposes, and also at the outer ends of the wings and the corners of the ranges, where the outer walls do not entirely conform in measurement to the common unit.

With the exception of the walls enclosing the rooms at the northern end of the north wing, the toilet rooms and the stairs leading to the lofts, which are of terra cotta, the partitions in the third story are built of expanded metal or metal lath, embedded in cement mortar and finished with plaster mortar to a thickness of 2 inches. The

metal is stiffened by means of 1-inch channel studs, spaced 16 inches. The typical door jambs have 2-inch channel bucks, but in the west wing most of the doors have wood bucks. The ceilings throughout the ranges are of the same construction, finished only on the lower side, and are supported by means of wiring from the 1-inch channels to 4-inch I beams, which run transversely across the ranges.

The corridors are all well lighted by means of transoms, and in addition each of the two corridors running north and south in the ranges extends to a window in the north wall. The side walls of the light wells in the wings are pierced by windows beginning at a height of 7 feet from the floor and extending to the ceiling, which is 12 feet high. The windows occupy the entire width of each of the spaces between the column piers, namely, 16 feet 8 inches, and are divided by mullions into three sashes, each of which is subdivided by vertical muntins into three lights. Of the lights thus formed the extreme outer one on each side is hinged to open. The same arrangement occurs in the walls at the outer ends of the light wells, but the width of the windows is reduced to 16 feet 6 inches. The construction is of steel and the glass is of ribbed and wired plate, ¼ inch thick. These windows open back of the cove at the top of the light wells and into the space above the ceiling lights. The corridor partitions enclosing the deep rooms at the outer ends of the east and west wings have large and practically continuous fixed transoms opposite those in the walls of the light well, designed to aid in the illumination of the inner parts of these rooms.

In addition to the borrowed lights above described there is, with minor exceptions, a transom above and individual to each door in the corridor partitions throughout the story. It has the width of the door opening, above which it extends 3 feet 4 inches, the upper 8 inches containing a wire ventilating screen while the remaining space is filled in with ribbed and wired glass. In the ranges, moreover, the upper panel of these doors is glazed with the same kind of glass.

Attic story.—The walls of the light wells in the attic or lofts, like those in the second story, are provided with windows which are, however, confined to the long sides. The openings have the width of the interspaces between piers, begin 3 feet 9½ inches above the floor and have a total height of 4 feet. The lower 2 feet 10 inches is divided by mullions into three sashes of nearly equal size, and each of these again by muntins into three vertical lights. Next above is a 2-inch transom bar, followed by long transom lights, 1 foot high. All trims, frames, sills, etc., are of molded steel, and all lights are stationary. The glass is wired plate with a ribbed surface. The outer end wall of each of the light wells has two doors, 4 feet 6 inches wide, which give access to the walks over the ceiling light.

Each of the wings contains certain constructions, described elsewhere, pertaining to the ventilating system, and a number of compartments have been enclosed by means of macite for the storage of specimens under special fire-proof conditions.

WALL, PIER AND CEILING FINISH

All steel structural columns in the several stories, other than those entirely concealed in double terra cotta walls, are so enclosed as to produce piers rectangular in section whether isolated or attached, the covering serving as a fire protection for the steel and adding to the appearance of the halls. In the north entrance lobby the enclosing material is marble, but elsewhere terra cotta, plastered, is exclusively employed. All piers in the first and second stories and also the finished brick piers in the ground story have plaster-molded caps and a base member of the same material surmounting a marble base corresponding with that of the adjacent or surrounding walls. In the third story and attic, however, the piers are finished plain, with a cement base in the third story.

In the first story of the wings the piers measure in section 2 feet by 3 feet, except the two corner ones near the outer ends of the wings which are 2 feet by 5 feet. In both the first and second stories of the ranges, where they are 2 feet 2 inches square over their greatest dimensions, they have pilasters on all sides, 19 inches wide and projecting 3½ inches. In the third story of the wings, except as noted, the terra cotta coverings are built into the walls of the light wells so as to form attached piers, 23 inches wide and projecting 17 inches. The corner piers at the outer ends of the east and west wings, four in all, which stand separate from the walls and slightly out of alignment with the other piers in the side rows, measure 23 inches square, while the two piers in the ranges, one each in the northeast and northwest corners, measure 23⅜ by 23⅝ inches. In the attic spaces of the wings the attached and detached piers of the third story are repeated, the former measuring 22½ by 15½ inches, the latter about 20 by 23 inches.

With the exceptions already and herewith noted, the surfaces of walls, piers and ceilings throughout the interior of the building have been treated with three-coat lime plaster having a fine lime putty finish. In all ornamental work plaster of Paris has been used in the proportion of 75 per cent of the mortar. All corners on plastered walls, piers and pilasters not otherwise protected are strengthened with heavy steel corner strips, extending 10 feet above the tops of the bases. Keene's cement of the quality known as "fine" or second grade has been employed for the architraves, jambs and heads of many openings, such as those between the wings and the ranges and

between the wings and the south pavilion in the several stories between the ground story and the attic, in certain parts of the middle section of the ground story and in the second story balcony openings through the light wells. Marble composes the entire wall finish of the north entrance vestibule and has also been extensively used in the adjoining lobby and in all of the toilet rooms.

In the east wing, in the central enclosed space in the west wing, and in certain small compartments of the ground story, where the walls have simply been painted, the arched contours of the ceiling construction have been left exposed, though the surfaces are plastered. All ceilings elsewhere below the attic, except that of the auditorium, have been finished flat, metal furring being generally used for the purpose in the ground story but not required in the other stories where the terra cotta construction is normally flat. In the third story the lower surface of the girder coverings is flush with that of the remainder of the ceiling, which is, therefore, uniformly level throughout. In the ground, first and second stories, however, the structural girders with their terra cotta coverings, extending crosswise of the wings and ranges and over the piers, project a considerable distance below the general surface of the ceilings. For appearance sake, false girders on metal furring, in imitation of the others, have been built longitudinally from pier to pier throughout each row, completing the general effect of a pronounced paneling of the ceilings. In the ground story the finished girders have a width of 3 feet and a projection of 1 foot 9 inches; in the first and second stories they are 1 foot 8 inches wide and project 2 feet 4 inches.

Other than the decorative plaster work of the south pavilion and north entrance vestibule and lobby, the panel over the north entrance stairs and the treatment of the light wells, molded work is entirely confined to the pier and pilaster caps and bases, and the ceiling girders, the soffit of each of which is recessed to form an elongated panel, their surfaces being otherwise plain.

All plastered walls, piers, and ceilings have been painted with several coats of white lead and oil, and finished plainly in accordance with a scheme of limited range of light colors, which has been admirably conceived and carried out. For the main walls and the piers throughout the first and second, or exhibition, stories, a uniform light grayish green has been employed, while the ceilings of these stories and the inner surfaces of the light wells as also of the screen walls in the east and west halls are in ivory and ivory-gray tones. Ivory tones have likewise been used for the plastered surfaces of the south pavilion, the north entrance vestibule and lobby, and the central hall in the ground story of the north wing.

The only decorative coloring is furnished by a large painting on canvas, measuring 25 feet long by 11 feet high, which is framed

against the wall surface of the second story at the eastern end of the central skylighted hall in the east wing. It is entitled "Diana of the Tides," and represents the goddess standing erect in her chariot, a rainbow-tinted sea-shell drawn by four horses which typify the flow of the tides, their action repeating and amplifying the rhythm of the breaking waves. The moon behind the goddess in the east rises through the purple shadows that follow the setting of the sun in the west. The work was executed by Mr. John Elliott and is a gift to the Museum from Mr. and Mrs. Larz Anderson.

FINISHED FLOORS

Four different kinds of material have been employed for the finished floors, namely, a terrazzo pavement throughout the first and second stories and in the north central hall in the ground story, all of which are intended for exhibition purposes, and also in the auditorium; marble in the south pavilion, the north entrance vestibule and lobby and the toilet rooms; wood in nearly all parts of the building which are constantly occupied by employees, including the entire third floor with the exception of a few rooms, both ranges and most of the side rooms of the wings in the ground story, and a few isolated rooms elsewhere; and cement in the wing spaces of the lofts, in the ground story east and west wings outside of the side rooms containing wood floors, in the corridor in front of the east freight elevator in the lower story, and in certain small rooms and closets in the first, second and third stories. The marble floors are described in connection with the several sections and compartments of the building in which they occur. The character and construction of the other floors are as follows:

Terrazzo floors.—The terrazzo pavement is of a high grade, containing a relatively large percentage of marble, the pieces of which range in size somewhat above the average customarily employed in this work. Two kinds of marble have been used, Sienna and Verona, the former varying in color from cream to a deep yellow, the latter being yellow and very dark red. The matrix consists of 1½ inches of Portland cement mortar, laid upon a base of Portland cement concrete which in turn rests upon the floor construction. These floors have been laid in rectangular blocks forming regular courses extending both lengthwise of and across the halls, but there is some variation in the dimensions of blocks and consequently in the widths of courses, which measure generally from 4 feet 7 inches to 5 feet 3 inches, in order to carry the pier base lines, etc. By first constructing alternate blocks in diagonal lines and allowing these to harden before the others were added, distinct joints have been formed between the blocks, designed to direct

the course of cracks occurring from any cause. The customary dull surface of the terrazzo floors has been brightened and the colors of the marble have been brought out by the application of a mixture of wax, raw linseed oil, turpentine and drier, followed after the lapse of a few days, by scrubbing with a weak solution of lye in warm water. The color effect so produced varies from a brownish to a grayish yellow.

Wood floors.—The lumber used for the wood floors is of uniform first quality Georgia pine, close edge grain, all heart wood, and specified to contain not exceeding 10 per cent of sound sap in any piece. The boards are 2½ inches wide, tongued and grooved, and dressed to a thickness of 1$\frac{1}{16}$ inches. The sleepers are of the same kind and grade of lumber. They measure 2 by 3 inches, and rest upon a concrete base. In the third story a shallow space or air chamber, with cement fire stops, underlies the flooring, but in the ground story the entire space between the sleepers is filled with cinder concrete. As all partitions except a few built since the completion of the building reach to the concrete base, the floors are individual to each room, connecting only at door openings.

Cement floors.—The cement floors consist of a top coating 1 inch thick, composed of Portland cement and clean sharp sand, followed by a binder, which in the ground story is 3 inches thick and is laid upon a concrete base, but in the other stories is 4 inches thick and rests directly on the floor construction. The surface, except in confined spaces, is cut by grooves into squares measuring from about 3 to 3½ feet across.

WALL BASES

Nearly all walls and piers in the several stories below the attic, with the exception of most of the east wing and the enclosed middle part of the west wing in the ground story, are finished with bases which have already been described for some parts of the building. Pink Tennessee marble, 12 inches high, occurs in connection with all the terrazzo floors, the marble floors outside of the south pavilion and toilet rooms, and the wood floors in the middle wing and ranges of the ground story. In the south pavilion and rotunda the bases are also of Tennessee marble, the roseal variety being used on the main floor and the pink variety in the galleries, but their height varies in the different stories. In the toilet rooms they are of white marble. Cement has been employed in connection with the cement floors, and also with the wood floors throughout the third story and in the ground story of the west wing. The bases of this material measure generally 12 inches high in the ground story and 8½ inches high in the third story. In a few small office rooms wood has been used.

WINDOWS AND DOORS

WINDOWS

There is a marked structural difference between the windows of the first and second stories, containing the exhibition halls, and those of the ground and third stories, the former being framed with metal while the latter have frames and trims of wood.

Ground story windows.—With a few exceptions, the windows in the ground story are of a common pattern, casement and wood construction. Those in the outer walls, where the openings measure 10 feet wide by 10 feet 6 inches high, are divided vertically by two mullions, each 3 feet to the side of the center of the opening. The large middle section so formed is subdivided into three equal parts by vertical muntins, and each of the narrow sides into three lights by horizontal muntins. Except in the east wing, only the two lower lights on each side are hinged to open, the movable sash being held in angle iron frames by smaller angle irons fastened from the outside. With a total window area of about 103 square feet, of which about 73 feet are glazed, the aggregate area of the movable sash equals about 14 square feet. A much larger area of movable sash, amounting to 46 square feet, is obtained in each of the windows on the south side of the east wing, where the carpenter and paint shops are located adjacent to the boiler and engine room, by providing three hinged sashes in the middle sections of the windows in addition to the typical side openings. The vertical and horizontal muntins of the center division of these windows are formed of 2-inch T bars.

The windows of the court walls agree in details of construction with those of the outer walls, but as the typical openings measure 11 feet wide and 11 feet 2 inches high, there is a corresponding increase in the size of the lights in both fixed and movable sash. The hinged sash are typical except on the north side of the east wing where they are similar to those on the south side of the same wing. Narrower court windows at the junction of walls, measuring 9 feet 5 inches wide, carry the same horizontal lines as the typical windows, but the vertical mullions and muntins are spaced to give movable and fixed sash of similar ratio to the total window width as in the larger windows. Of the eight large doorways in the court walls five have been transformed into windows by closing the lower part of the openings which are of the same width and character as in the typical windows.

The window construction is of white pine, except the hanging stiles which are of yellow pine; the inside casings, trims, sills, aprons, etc., which are of cabinet oak; and the iron work of the movable sash. The glass is polished plate and clear, except in the toilet rooms where it is ground on the inside face.

Exceptions to the style of window above described, varying in size, mostly narrow and all of iron construction, occur in the south and north pavilions, and in the court walls of the stair towers and service stair wells.

First and second story windows.—In order to adequately light the wide exhibition halls, the extent of window surface as compared with wall surface in the first and second stories has been made proportionately very great. The window openings, as elsewhere explained, are continuous through both stories, measuring 31 feet 10 inches high in the outer walls of the east and west wings, and 31 feet 6 inches high in the range and court walls, from the top of the masonry sill which is 3 feet 11 inches above the first floor level. In the outer walls of the east and west wings they reach to within 5 feet 2 inches of the ceiling of the second story, and in the range and court walls to within 5 feet 6 inches of the ceiling. The width of the openings is 11 feet 6 inches in the outer walls and typically 11 feet in the court walls, making the intervening piers 7 feet wide in the former and 7 feet 6 inches wide in the latter.

The window construction, which carries the effect of a single window throughout the entire height of each opening, is almost entirely of molded steel, rigidly fastened to the masonry of the opening. Though substantially put together, it presents an appearance of great lightness and permits the use of an exceptional amount of glass for the area covered by the frame. The windows are deeply recessed from the outside, but are nearly flush with the interior surface of the walls. The panels which separate the upper from the lower windows and cover the steel construction of the second floor where it crosses the openings are 2 feet 11 inches wide and built of No. 20 steel, decorated on the outer surface with rosettes of stamped zinc inserted in molded panels.

With respect to their framework, the windows are divided by 4½-inch mullions into three principal sections, and the middle and larger section again by 1½-inch vertical muntins into three parts. These vertical lines carry through both stories. In the first story the two side divisions are divided by horizontal muntins into five equal lights. The lowest muntin, however, also extends entirely across the window, and the two outer subdivisions thus formed in the central section of the window have lights with angle iron frames, hinged at the top to open out. In the second story the side divisions are also divided by muntins into five parts, the upper division being smaller than the others, and the line carrying entirely across the top of the window as a transom bar. As in the first story, the lower muntins also extend across the middle division and there are two movable sashes in each window, being the second light from the bottom in each side or jamb division.

The frames, sills, mullions, muntins and inside trim are entirely of No. 20 gauge molded steel. On the exterior where the metal has contact with the stone or brick work, heavy tinned sheet copper has been used. The sills and other projections on which workmen are likely to step in cleaning or painting are filled with concrete, and all muntins are stiffened with a metal core. The glass is polished plate, ¼-inch thick, with the inner surface evenly ground, except in the north pavilion where it has been left plain. It is held in the frames by a fixed molded metal bead on the outside and a movable wood bead on the inside. The metal work on the exterior has been painted a light color in harmony with the white granite.

The inside sill of the first story windows is 4 feet 4½ inches and the lower glass line 4 feet 7½ inches above the floor line. The window height from glass line to glass line is 14 feet 5½ inches. The glass area in each of the outer windows is 149 square feet, of which 12½ square feet is movable. In the court windows of the same floor the glass area is 142 square feet, of which 12 square feet is movable. In the second story the sill line is only 4¾ inches, and the glass line 6 inches above the floor level. The window height from glass line to glass line is 13 feet 6¾ inches in the outer walls of the wings and 13 feet 2¼ inches in the ranges and all court walls. The glass area is as follows: In the outside windows of the wings, 139 square feet, with 7 square feet movable; in the outside windows of the ranges, 136 square feet, with 6⅝ square feet movable; and in the windows of the courts, 129 square feet, with 6⅝ feet movable.

Windows other than those of the typical size and construction, being smaller and of simple design with metal frames, occur in the first and second stories in the walls of and adjacent to the stair towers and those of the service stair wells on the court side, and in the lateral projections of the north pavilion and the recessed walls of the south portico.

Third story windows.—There are three general sizes of window openings in this story, but the windows are all of the double-hung type, the sash opening at both top and bottom. The openings in the façades of the east and west wings are in pairs separated by a granite mullion, and measure 4 feet wide by 6 feet 8 inches high. Those over the entrances in the north pavilion are also in pairs, but of slightly larger size, while the dormer openings of the ranges are 5 feet wide by 7 feet high. The typical openings in the court walls are 11 feet wide by 7 feet high, but are divided into three sections by wood mullions, the middle section being much wider than the others; and the smaller court windows, 9 feet 5 inches wide, are divided in the same manner. In all of these windows white pine has been used for the sash, outside sills, staff beads, etc.; and cabinet oak, for the inside casings, trims, stools, etc. The glass is polished

plate and clear, except in the lower sash of the toilet rooms where it is ground on the inside.

OUTER AND COURT DOORS

The doors at the north and south public entrances to the building have already been described. Those at the three other entrances are as follows: The opening into the ground story of the south pavilion from the passageway under the main approach, measuring 6 feet wide by 13 feet high, is provided with double doors, having a large glass panel in each leaf, and a transom. The openings and doors at the wagon entrances, of which there are two at the outer ends of both the east and west wings, are identical in all respects. The openings are 10 feet wide by 15 feet 10 inches high, and the doors are double-leaved, entirely of wood, 2½ inches thick and paneled, the two lower panels of one of the leaves on each side of the building being hinged to form a wicket gate. The doors are pivoted at the jambs, top and bottom. At the edge of the wagon platform inside of the northern door of this series on the east side, a large hinged door screen in four sections or leaves has been introduced, mainly to keep out the dust from the coal which is delivered to the bunker in the driveway at this place. It consists of wood framework covered with sheet steel, fills the entire opening which is 15 feet 8 inches wide by 16 feet high, and is provided with a small wicket gate.

In the three large openings in the court walls of the ground story finished to give access to the courts, the doors, which are glazed, correspond with the windows in appearance and measure 10 feet 6½ inches wide by 9 feet 6 inches high, having a transom above. They are double-leaved, 2¼ inches thick, and have wood frames and trims. The bottom rails carry the sill line of the adjacent windows and have horizontal panels. Above the rail each leaf is divided into three vertical lights by muntins, the same divisions continuing through above the transom bar. There is also a small glazed wood door opening into the courts at the base of each stair tower.

INSIDE DOORS

While a great diversity exists among the doors provided for different parts of the building, the majority, being chiefly those connected with the rooms in the ground and third stories, conform to a common pattern and are of two sizes. Both steel and wood have been employed in their construction, principally the former, and the doors of this material have been distributed with reference to securing as adequate fire protection as possible for the rooms individually and for sections of the building. The doors not belonging to the common pattern have mostly been designed to meet special requirements and

have in part been described in connection with those parts of the building in which they are located.

Closing the large openings in the ground story between the east and west ranges and the east and west wings, respectively, which measure 12 feet wide by 15 feet high, are doors and transoms of small lights of glass framed in steel and so subdivided and hinged that any part or all of the structure may be opened. The corresponding though smaller openings between the ranges and the north wing at the entrance lobby have double doors of large plates of glass set in bronze frames. The three partitions dividing the construction and repair shops along the south side of the east wing in the ground story have communicating openings 8 feet wide by 10 feet high, and there is another opening of the same size giving access to this suite of rooms from the corridor in front of the boiler room. All of these are provided with single-leaved doors of vitribestos framed and stiffened by steel bars and angles, hung on an inclined overhead track, and arranged to close automatically by gravity in case of fire through the melting of a fusible link in the rope by means of which they are held open. As they are intended to be kept generally closed, each has a small wicket gate for ordinary use. The auditorium entrance doors and those at each end of the adjoining lobby, all double-leaved, occupy semicircular-headed openings of approximately the same size, but the former are of black walnut with a transom, while the latter are of steel and the doors themselves fill the entire opening. There are double steel doors in the walls closing the ends of the two main corridors in the west wing of the ground story, and each of the two rooms at the outer end of this wing has double steel-covered doors on the side facing the wagon entrance in addition to a door of the typical pattern at the principal entrance. The small rooms in the several stories on the south side of the south pavilion are all provided with wood doors, but the twelve openings occurring between this pavilion and the three wings in the third and attic stories are occupied by heavy double steel doors.

The typical room doors used in the ground and third stories are 7 feet high and of two widths, 3 feet 6 inches and 3 feet, the former being the width of the entrance openings in the corridor walls and the latter that of the communicating openings between rooms. The total number of doors of this pattern is slightly in excess of three hundred. It was the original intention to have them all of steel, but for reasons of economy wood was substituted for about one-third of the number. In the distribution of the two kinds, metal has been selected for the corridor openings and wood for the communicating openings, with the following principal exceptions: All of the typical entrance doors in the east and north wings in the ground story are of wood, since the fire risk is not serious in either of these

places, and metal has been used in both stories for a number of the communicating doors which are so distributed as to furnish complete fireproof walls at intervals in each of the sections enclosed by the corridor partitions. In the third story the doors of the toilet and housekeeping rooms and the closets under the several attic stairs are of wood.

The doors of both materials are made alike on the two sides. They are constructed with a single large sunken panel, except in the case of the entrance doors in the ranges of the third story, which have two panels, one above the other, the upper being of glass to facilitate the lighting of the corridors. The wood doors are of red oak veneer on a core of white pine, stained a slightly greenish brown color and having a dull cabinet finish. The metal doors are of molded pressed steel, with the stiles and rails $1\frac{5}{8}$ inches, and the panel $\frac{5}{16}$ inch thick, the latter being surrounded by $\frac{7}{8}$-inch molding. The space intervening between the metal of the two sides is filled with a fire-resisting composition. These doors are painted and grained in close imitation of the wood doors, and while much heavier their greater weight is scarcely appreciable in opening and closing.

In the ground story the stiles and top rail of all doors are 5 inches wide, while the bottom rail is 12 inches wide and in all entrance doors has built into it a cast-iron electro-bronze plated register of the width of the panel and 6 inches high, to aid in the circulation of air between the corridors and the rooms. The single paneled doors in the third story have the same width of stiles and top rail, but the bottom rail is only $8\frac{1}{2}$ inches wide and lacks the register opening. These measurements also apply to the entrance doors in the ranges of the third story, which, however, have an intermediate rail 6 inches wide at a height of 3 feet 2 inches to its center above the floor. The lower and smaller panel so formed is of metal, but the upper is set with ribbed and wired glass.

In the 9-inch brick walls of the ground story the doors are hung at one side of the opening, the inner in the case of entrance doors, and the other side has a plaster reveal returning into the jambs and stopping against wood bucks. With the metal doors, a metal staff bead covers the joint between the plaster and the buck and metal trims are provided on the door side, the bucks being thereby wholly covered with steel. Wood trims accompany the wood doors.

In the 2-inch expanded metal and plaster partitions of the third story most of the door openings are framed by 2-inch channel iron bucks, which, in the case of entrance but not of communicating doors, extend 3 feet 4 inches above the door for transom purposes. The upper 8 inches of this area has a ventilating screen of No. 12 bronze wire with $\frac{1}{8}$-inch mesh, the remaining space being glazed with ribbed wire glass. All transom bars and all parts connected with the ma-

jority of the metal entrance doors are of metal without trims on either side. On the south side of the west wing, however, there are metal trims on both sides of all openings having metal doors and wood trims where wood doors occur. These door openings, moreover, are provided with wood bucks, as are also those in the terra cotta partitions of the suite of rooms at the north end of the north wing, the toilet and housekeeping rooms, and the attic stairs.

All entrance doors open into the rooms and all doors have wood thresholds except those of the toilet rooms in the third story and the rooms opening into the middle hall in the ground story, which are provided with marble thresholds, and two of the small rooms communicating with the north entrance lobby, where the material is cement.

All doors of the typical pattern are hung with three 4½ by 4½-inch hinges, except the wood communicating doors fitting against metal bucks in the third story, which have two 4-inch hinges. The locks are morticed and of the paracentric pattern. A large number of the entrance doors are also provided with checks of the Blount type and with stops. Essentially all exposed parts of the hardware are of cast bronze, antique color, or electroplated in imitation thereof.

MISCELLANEOUS

STAIRS

The building contains three stairs for public use, two of which occupy the tower-like constructions at the northern corners of the south pavilion, the third being located on the eastern side of the north pavilion. Beginning in the ground story, the former extend to the attic or fourth story, while the latter stops at the third story. They are of similar detail treatment, consisting of marble and ornamental iron work fastened on structural steel framing, but differ in the arrangement of the runs and platforms. The wells of the tower stairs are elongate in plan and 13 feet 10½ inches wide by 35 feet 8½ inches deep, but that of the northern stairs is practically square, measuring 22 feet 3½ inches across and 22 feet 5¾ inches deep. Ten-inch stringer I beams, carried in three lines, one under the center and one on each side of the runs of stairs, furnish attachment for the metal work necessary to support and fasten the steps, facia and handrails, and also enter into the framing of the platforms between floors. The width of the tower stairs from the wall to the center of the handrail is 5 feet 11½ inches, and of the northern stairs, 6 feet.

Beginning with a cast-iron newel in the ground story, the rail is continuous on all runs and platforms to the top of the stairs. The rail proper is of cast iron but the other straight members are of wrought iron. The latter carry a continuous volute and rosette mo-

tive in cast iron, which forms the principal metal ornamentation of the sides of the stairs. Below this the string has top and bottom leaf decorative bands of cast iron, which form a frame for panels of polished roseal Tennessee marble, continuous with the runs and platforms. The level sections of the rail, which occur only on the floor levels, are 3 feet and the raked sections 3 feet 3 inches high from the riser line to the top of the rail. Where the northern stairs cross the window openings grilles corresponding in detail and height to the stair rail are provided on the window side. With the tower stairs, however, grilles carrying the same horizontal members as the rails, but having vertical bars instead of the running volute motive, occur.

The treads, risers and platforms are of gray Tennessee marble with a fine hone surface. In all stairs the lower steps in the ground story curve around the newel, which rests upon a solid block of marble. The curved treads and risers are in several pieces, but the straight ones are each of a single piece. The rise of the steps is 6 inches; the treads are 2½ inches thick and the straight treads 12 inches wide from nose to nose. The landings of the northern stairs between floors are in single marble slabs, while those of the tower stairs are tiled and bordered. The side walls of the wells and the under sides of the stairs are plastered.

Besides the public stairs, there are two small service stairs, one on each side of the building adjoining the freight elevators, which extend from the ground story to the third story. The wells are 9 feet 2¾ inches wide and are occupied to a depth of 17 feet ⅜ inch. These stairs are 3 feet 4 inches wide, and have two long runs and one short cross-run with intervening platforms in each story. The stringers, treads, risers and newels are of cast iron, but the balusters and the top and bottom rails to which they are fastened are of wrought iron, with oak handrail. The treads have sunken panels which are filled with rubber tread mats.

In addition to the southern public stairways, access to the attic from the third story is furnished by four flights of service stairs, one near each of the freight elevators and two in the northern end of the north wing. These stairs are 4 feet 6 inches wide and have walls on both sides. They are built entirely of cast iron. The main roofs are reached from the attic by means of steps at the northern end of the north wing, and the pediment roofs of the south pavilion by stairs from the fourth story leading to doors in the drum of the rotunda.

ELEVATORS

The building is equipped with six electric elevators of the Otis Elevator Company pattern, four being for passengers and two for freight. The former are arranged in two pairs, one of which is

located in the south pavilion, the other in the north pavilion, thus furnishing service at the two main entrances. The southern elevators run from the ground story to the fourth story, and their machinery is placed at the top of the hatchways in the attic of the pavilion, but the northern run only to the third story and their machinery is contained in a pit below the level of the ground floor. The machines are of the tandem worm and gear type with motors of about 25 horse power each. The southern cars measure 4 feet 10 inches by 7 feet 6 inches, the northern 6 feet by 6 feet 6 inches. All have a live load capacity of 2,500 pounds at a speed of 250 feet a minute, and a maximum capacity of 3,000 pounds at 200 feet a minute. The doors to the southern elevators are separated by a narrow wall space, but at the northern entrance the cast-iron grille work extends continuously across both elevators on all floors.

The freight elevators are placed one on each side of the building at the southern end of the ranges where they adjoin the east and west wings. They travel from the ground story to the attic and in the lower story are near the two large entrances to the building at which freight is received. The inside dimensions of the two cars, which are identical in all respects, are 7 feet 3 inches by 11 feet 4 inches by 12 feet high, and their lifting capacity is 6,000 pounds at 70 feet a minute, with an overload capacity of 12,000 pounds at slow speed. The machines, which are of the same size and type as those connected with the passenger elevators, are contained in separate glazed enclosures located on the ground floor in the adjacent part of the wings. The gates at the openings on all floors except the attic are of a simple folding pattern in pairs, running on a top tubular track and a sill track at the bottom, and are so installed that the gates, after folding, may be swung far enough to the sides to uncover the entire width of the car, and the overhead track removed.

TOILET ROOMS, LAVATORIES, ETC.

The toilet rooms are all located in the ground story and third story. The public rooms occupy two bays, or a length of approximately 36 feet, on each side of the north wing in the ground story adjoining the north entrance lobby, and in the same story there are also two rooms for men employees, one each in the east and west wing. The third story contains two general rooms in the north wing and two small toilets connected with offices.

In their construction and appointments these rooms comply with the most exacting plumbing and hygienic requirements. All of the main toilets, with one exception, consist of two rooms each, the anterooms for women being fitted up as rest rooms. Of the ground story rooms for men employees one has an anteroom furnished with

lockers, while the other has a shower bath attached. White Vermont marble has been used extensively in the finishing, all floors being of this material in 10 by 20-inch tiles with an 8-inch border. The anterooms, except in some cases where they are separated from the toilet rooms by 7-foot high marble partitions, have a 12-inch marble base, but the toilet rooms proper and the anterooms referred to are wainscoted with marble to a height of 7 feet. The plumbing partitions, also of marble, line with the wainscoting. All wall surfaces above the marble, as well as the ceilings, are plastered.

A number of the smaller rooms in each of the four main stories have been fitted up for housekeeping purposes. They have cement floors and contain slop sinks of painted cast iron. Wash basins and sinks are provided in the laboratories, work rooms and offices where required. They are of enameled iron except in the case of some of the sinks which are of soapstone. The plumbing pipes for hot and cold water and the waste pipes are contained in the pier chases of the outer and court walls and may be tapped as additional fixtures are called for.

TUNNELS

The ground floor of the building having been constructed with reference to its use for regular museum purposes, although containing the boilers and machinery of the mechanical plant, and the site being too low in respect to the sewerage system of the city to permit of the addition of an underground story, the distribution of the heating and other mains has been provided for in a series of tunnels directly underneath the ground floor. These tunnels follow the exterior and court walls of the building, except at the outer ends of the wings and under the south pavilion, where their continuance is obstructed, while cross branches at intervals afford additional means for passing from one side to the other of the wings and ranges. The side tunnels are built against the foundations and as one with them. All are of concrete and measure in the clear at least 4 feet 6 inches both in width and height. The thickness of the bottom is 6 inches, and of the side walls and top 9 inches. The roof is flat and reenforced with expanded metal; its upper surface is 7 inches below the ground floor, through which access to the tunnels is had by means of cast-iron trap doors. Terra cotta cellular conduits for the electric wires extend along both sides, while the pipes are supported on brackets and hangers. Connection with the several floors is made through the vertical chases in the outer and court wall piers, which extend from the tunnels to the attic.

MECHANICAL EQUIPMENT

CHARACTER AND LAYOUT OF THE MACHINERY PLANT

The heating, lighting and ventilation of this large building, in view of its great open spaces, call for a relatively extensive plant, and the one that has been installed embodies the best of recent improvements in steam and electrical engineering. Its capacity having been gauged to meet the requirements of the older buildings also, an economy has been secured in the maintenance of the museum service generally. It is unfortunate, however, that the plant could not have been located in a separate structure, on account of the annoyance caused by coal dust and soot and by the vibration produced by certain parts of the machinery, troubles that can best be remedied by the establishment of a central power plant for the Government buildings in the western part of the city, as has been proposed.

Essentially all of the ground story of the east wing except the series of rooms along the south side, used as carpenter, metal and paint shops, and a storage room at the east end, has been given over to the purposes of the plant. The layout of this space, including the positions of the principal pieces of machinery, is shown in the accompanying diagram (plate 12). The coal bunker is located on the north side of the inner driveway. Beyond an intervening corridor is the boiler room, with the boilers (A, A), enclosed in front and at the sides by a wall, having a vertical sliding door at each end, to prevent as much as possible the dissemination of dust as the coal is passed to the hoppers. Adjoining the boilers on the north is a stoker fan (B). The machinery room which follows occupies the entire middle part of the wing between the outer rows of piers. It is open at the western end but enclosed on both sides by walls provided with large glass transoms. It contains four electric generators with engines (C), three of which are arranged along the southern side of the room, while the fourth, of smaller size, is on the northern side near the boilers. The other machinery consists of two boiler feed-water pumps (D), the blow-off tank for the boilers (E), feed-water heater, oil separator and drain pump (F), high-pressure service and fire pump (G), hot water service pump, motor, tank and heater (H), vacuum pumps, heaters and circulating pumps for the house heating system (I), drain pump, receiving tank, etc., located in a pit (K), and vacuum cleaning apparatus (L).

At the western end of the room is the electrical generator switchboard (M), and in the northwest corner of the wing, the main electrical distribution switchboard (N). A suite of rooms along the northern side of the wing furnishes an office for the engineer and machine and plumbing shops.

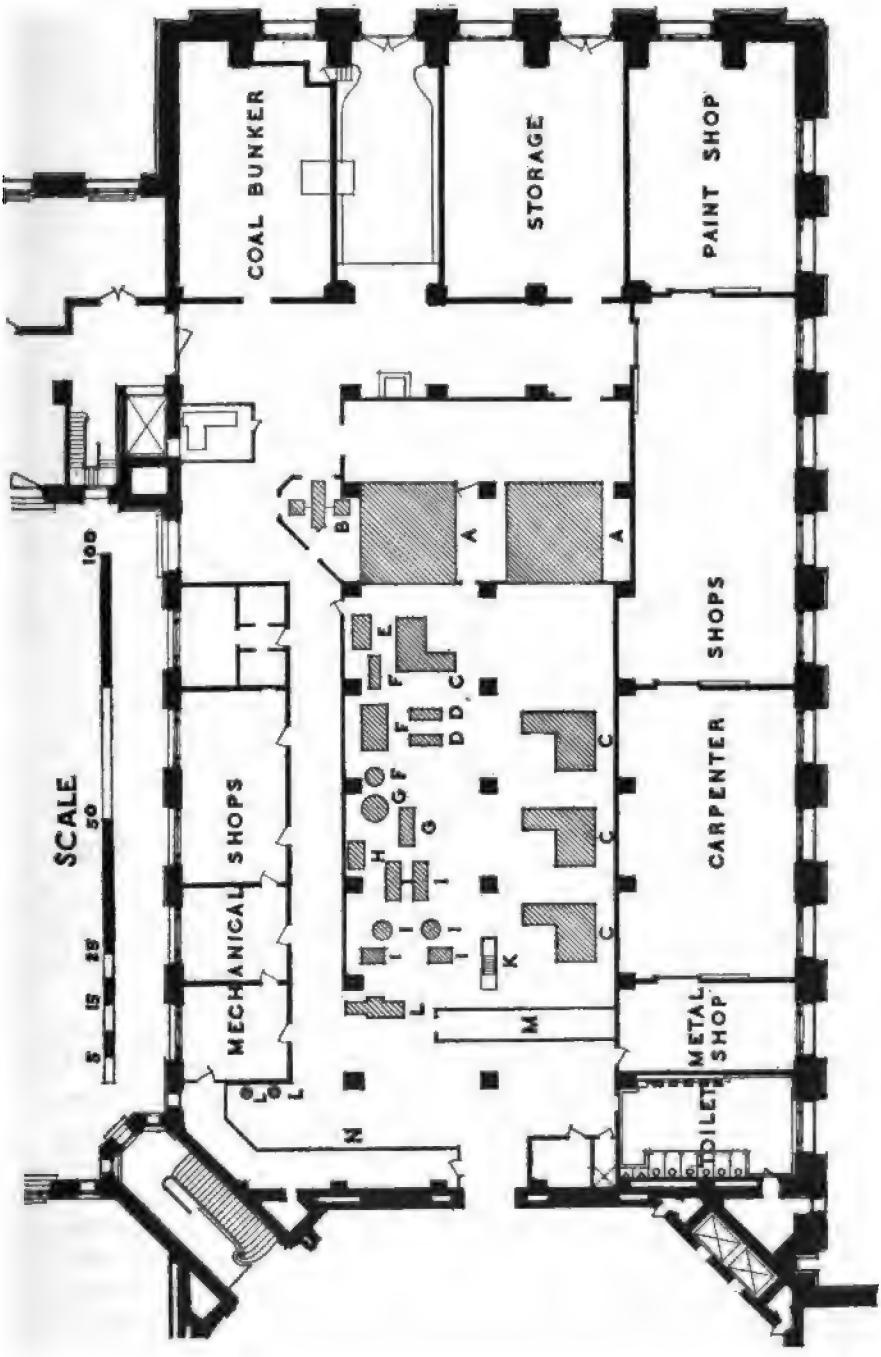
STEAM GENERATING AND HEATING EQUIPMENT

Boilers and steam mains.—For the production of steam there are four Geary high-pressure water tube boilers, each with a nominal rating of 175 horse power and carrying a steam pressure of 100 pounds. They are set in two batteries. Each boiler is made up of 100 4-inch tubes, 16 feet long, inclined at an angle of approximately 15° to the horizontal, and directly expanded into solid steam headers with a steam drum, 24 inches in diameter, resting in a horizontal position. The steam headers, one at the front and one at the back, are riveted to and so connected with the drum that the circulation of water is free and not retarded by contracted vein.

The boilers are fired by means of automatic Taylor gravity feed stokers, with forced draft obtained by means of a 6-foot Sturtevant blower, driven by an engine of the same make. There are, in fact, two of these engines, one on each side of the fan, one of which is kept in reserve while the other is running. The stokers are operated by means of a main shaft extending through the ash pit and connected to the fan shaft by a silent chain drive. The speed of the fan and stokers is regulated automatically through a Locke draft regulator. When the speed drops below a predetermined point, which is 100 pounds pressure, a damper regulator opens a valve furnishing steam to the engine of the fan, thus increasing its speed and at the same time the draft and the speed of the stokers. As soon as the steam pressure exceeds another fixed point, namely 103 pounds, the regulator stops the fan engine, thus closing down the draft and decreasing the speed of the stokers. In this manner the fire in the furnaces is controlled without the close attention of anyone. Williams' automatic boiler feed regulators are used for maintaining the water in the boilers at a constant level.

A 9-inch steam main passes along and above the fronts of the boilers, with which there are 6-inch connections through large radius pipe bends to allow for expansion without undue strain on the main. The main is carried back along the side of the outside boiler of each battery, one branch continuing along the side of the engine room, the other through the middle of the room, with 7-inch bend connections to the three large engines and a 5-inch connection to the smaller one. The two branches are brought together near the western end of the engine room, and contain numerous gate valves which make it possible to cut any section of the main out of service for repair without closing down the plant.

The main exhaust line for the engines and pumps, 14 inches in diameter, runs through the middle of the engine room in a large trench under the floor. At the western end of the room it rises and passes along the adjoining corridor to the smoke stack, up which it is carried to within about 10 feet of the top. The exhaust steam



PLAN OF GROUND STORY, EAST WING, SHOWING LAYOUT OF STEAM AND ELECTRICAL PLANT.

A, Boilers; B, stoker fan and engines; C, electric generators and engines; D, boiler feed-water pumps; E, blow-off tank; F, feed-water heater, oil separator, and drain pump; G, high-pressure service and fire pump; H, hot water service pump, motor, tank, and heater; I, vacuum pumps, heaters, and circulating pumps for the house-heating system; K, drain pump, receiving tank, etc.; L, vacuum cleaning apparatus; M, electrical generator switchboard; N, electrical distribution switchboard.

being there discharged at an angle of 45° directly across the stack, it becomes superheated by contact with the hot gases and passes to the atmosphere generally invisible to the eye. The exhaust main contains an automatic back pressure valve which automatically opens in case the vacuum is lost and closes when the vacuum pumps are started. At the point where the main rises from the trench a small vacuum pump, 3½ by 5 by 5 inches in size, is located in a pit. Its purpose is to remove the water of condensation which collects there, and discharge it into a large blow-off tank behind the boilers. The steam separators over the top of the engines, as well as all drips to the main line, are connected through a system of pipes to a Holly return device which returns the water of condensation to the boilers automatically without the use of traps or pumps. In all other places where water is liable to accumulate connection is also made to the Holly system so that there is no likelihood of trouble through water hammer.

The boiler feed pumps, two in number and measuring 8 by 5 by 12 inches, are connected so that either can be run while the other is undergoing repairs or held in reserve. Their speed is automatically controlled through a regulator, which closes off steam from the pump when the feed regulators on the boilers stop the passage of water to the latter. There is a large feed-water heater composed of a number of 1-inch horizontal copper tubes through which a part of the exhaust passes, the condensation being removed by means of a 6 by 8 by 12-inch vacuum pump. The water from the oil separator passes to the heater to which the suction of the feed pump is connected. A city water supply connection is also made to the tank to replace what is lost between the engines and the oil separator.

Handling of coal and ashes.—Bituminous coal is used in the furnaces, but with the type of stoker employed the amount of smoke produced at any time is inappreciable. The coal requires to be crushed and is delivered in that condition.

Two coal bunkers have been provided. They are located at the outer end of the east wing, one on each side of the inner wagon drive the width of which was reduced to one-third its original dimension to subserve this purpose. The northern bunker, the floor of which is on the same level as that of the story, has a capacity of about 350 tons. The southern bunker, whose floor level corresponds with that of the driveway, has a capacity of some 475 tons and was intended as a reserve storage. Its use for this purpose after a short trial has, however, been at least temporarily abandoned since the one bunker has been found to answer the requirements.

The coal is handled mechanically, the machinery being located in the northern bunker and operated by a 5 horse power motor. As it

is dumped from wagons on a grate in the driveway at the side of the bunker, it passes by gravity down a chute and into a series of buckets attached to an endless chain, by which it is conveyed to a point near the ceiling and delivered to a spiral running in a trough suspended from the ceiling. This spiral is pivoted at one end and connected to the driving shaft through spur gears so that its outer end, moving in a circular track, can distribute the coal to any point in the room. The coal for the reserve bunker must first be taken into the northern one, from which, after being lifted to the higher level, it is carried over the driveway by means of a second spiral, but as this is in a fixed position, in order to completely fill the bunker, the coal has to be partly distributed by hand.

For conveying coal to the boilers, two steel cars, of one ton capacity each, are employed. They run on an industrial railway track leading from each bunker across the corridor into the boiler room, and thence along the fronts of the boilers. The coal is passed from the cars to the hoppers of the stokers by hand.

The ashes from the furnaces are dumped into pits, one under each boiler, whence they are drawn into a car having a capacity of one cubic yard and running on a track in a main pit extending along the entire front of the boilers. From a branch opening in the adjoining corridor the car is lifted by an electric hoist and moved along a suspended trolley to the east driveway where the ashes are emptied into carts.

Heating system.—The heating system of the new building is of the hot water type direct radiation. The water is brought to the necessary temperature by means of heaters of the Alberger Condenser Company's make, two of which are provided. These machines consist of cast-iron bodies with corrugated copper tubes made into cast-iron heads, and are so designed that the water entering the bottom passes three times through the tubes before leaving the heaters at the top. Exhaust steam from the engines and pumps circulates around the tubes. When the exhaust is not sufficient in quantity live steam is added to make up for the deficiency, being introduced through either a 4-inch connection to the live steam main or a 6-inch connection to the exhaust main, which contains a Bridgman Brothers automatic reducing valve. To care for the expansion of water in the system a tank is located in one of the flues in the rotunda walls at a height of about 20 feet above the third floor. An automatic ball cock connected to the city water supply keeps the water in the tank at a constant height, while an overflow to the sewer carries off any surplus as expansion takes place due to increase in temperature. Circulation through the system is forced, the power being supplied by two volute Alberger pumps, direct connected to Westinghouse motors of 20 horse power capacity. The two heaters and pumps are duplicates, one of each being held in reserve while the other is in use.

Pipe connections and radiators.—The hot water distribution pipe, 8 inches in diameter where it leaves the heaters, passes through a flue at the west end of the east wing directly to the attic. It there branches in three directions, one branch supplying the entire south side of the building, another the north side of the east wing, and the third the remainder of the building. To decrease the friction in the pipes they are greatly increased in size on reaching the attic. Connected with these mains are 130 drops located in pier chases of the outer and court walls, these pipes being mostly 1½ inches in diameter, although a few are only 1¼ inches.

There are four radiators on each drop, one for each of the four stories, except in the east wing where there are only three, the ground story being otherwise heated. Wherever possible radiators have been placed under or at the base of the windows, with two connections to the drop, both at the same end of the radiator. To compel the passage of water through the radiators the connections to the drops have been made as large as, and in some cases larger than, the drops themselves, and long turned fittings have been used, joined in such a way as to secure the least possible friction to the flow of water to the radiators. The radiators are furnished with Norwall packless radiator valves of the globe pattern.

The drops are connected to hot water mains in the tunnels under the ground floor in a manner similar to the connections in the attic. These mains, which return the water to the circulating pumps, are run along the ceiling of the tunnels and brought together into a 10-inch main near the pumps. To allow for expansion of the mains, loops are located both in the attic and in the tunnels, thus obviating the use of expansion joints. The drops are provided with valves in the same places, and also with drain cocks in the tunnels so that any drop can be separately drained without disturbing the system. The attic valves are of the lock shield type opening by means of a key, which prevents their being tampered with. The mains in the attic and tunnels are likewise supplied with valves so disposed that different sections of the building can be cut out of service, an arrangement found necessary for the proper adjustment and convenient operation of the entire heating system.

The radiators used in the new building are of the Peerless type; they range in height from 22 to 38 inches, and are two and three columns. Their length varies according to location, and some of those in the main exhibition halls, where they occupy the full width of the window surface, consist of as many as 50 sections. The total number installed is about 465, furnishing approximately 70,000 square feet of direct and 3,000 square feet of indirect radiation surface.

Heating of ground story of east wing.—For heating the ground story of the east wing, in which the mechanical plant is located, the

following method has been adopted in place of the general system: On a platform suspended from the ceiling between the boilers is placed a 4-foot Sturtevant steel plate, full-housed fan, having its discharge connected to a series of galvanized iron ducts carried along the ceiling, with openings opposite each window. Dampers in the branches from these distributing ducts permit the amount of air delivered to be regulated. The principle involved is the removal of the hot air which collects above the boilers and its discharge in the several rooms at the points mentioned, the rooms being thus warmed without the expenditure of energy other than that represented by the motor operating the fan. This scheme is quite a departure from the ordinary, and it has worked satisfactorily.

Steam connections with other buildings.—The steam for heating the several buildings occupied by the Museum on the southern side of the Mall is now supplied from the new plant through the medium of an underground tunnel which extends from the east wing of the new building to the Smithsonian building a short distance east of the main entrance. The tunnel is 730 feet long, 4 feet wide and 5½ feet high, and has a flat roof. It is built of concrete reenforced with steel rods, and is 6 inches thick on all sides. The top is sloped and troweled to a smooth surface, and covered with a coat of tar paper followed by 3 inches of sand to prevent seepage. It has also been constructed with reference to its drainage to a given point, so that any water that may enter can be removed by means of a steam siphon.

The steam pipe running through the tunnel is 4 inches in diameter. Starting from the 9-inch main near the boilers, it enters the old 5-inch main in the Smithsonian building under the east door. The steam pressure at this point, namely, 80 pounds, a loss of 20 pounds in the passage from the boilers, is continued to the boiler room in the older Museum building where the pumps are located. Three reducing valves belonging in the original system are used to further diminish the pressure from 80 pounds to approximately 15 pounds. The pumps return the water of condensation to the new plant through a 2-inch pipe. There has been no material change in the heating system of the older buildings which is by means of steam, the original pipes and radiators remaining in use. The heating surface in these buildings is practically all of the direct radiation type and amounts to about 20,000 square feet.

ELECTRICAL EQUIPMENT

Use of electricity.—Electricity is generated for both lighting and power. With the exception of the generator engines, the two stoker engines and the six pumps in the engine room, which are operated by steam, all motive power is supplied by electricity, including the

running of the elevators, the ventilating fans, the machinery connected with the handling of coal and ashes, the refrigerating plant, the vacuum cleaning machine and the machinery required in the shops and laboratories. The number of outlets for the attachment of lighting fixtures is especially large, and their distribution is based on a systematic plan.

Machinery.—The electrical machinery consists of four engines of the Ridgway Dynamo and Engine Company's make and four Westinghouse 3-wire generators, and space has been reserved for the installation of an additional unit in the future should it be called for. Three of the engines are of the 4-valve Corliss type, 19-inch bore and 18-inch stroke, without dash-pot cut-off, developing 250 horse power at 200 revolutions a minute. The fourth engine is smaller, of the plain slide valve type, 13-inch bore and 14-inch stroke, developing 130 horse power at a speed of 165 revolutions a minute. All of the engines rest on splayed concrete foundations, 5 feet thick for the larger ones and 4 feet for the smaller one, which are in turn underlaid and surrounded by 1 foot of sand. The generators are direct connected to the engines, the three attached to the larger engines having an output capacity of 150 kilowatts each, and the smaller one of 75 kilowatts, at voltages of 115 and 230. The smaller engine and generator are more especially designed for night service when the building is not open.

Switchboards and distribution panels.—The generator switchboard, which is located at the western end of the engine room, receives the cables from the generators through terra cotta conduits. The connections from each generator comprise six cables of 900,000 circular mils, four of 300,000 circular mils, and two No. 8 wires. This switchboard consists of fifteen marble panels, assigned as follows: Four to the generators now installed and one to the reserved unit; one each to the lighting service of the four stories; one to the patrol and rotunda lighting; one each to the fan and elevator services; one to the older buildings and neutral service; one to tie and breakdown switches; and one to miscellaneous use. The generators are so designed that a 3-wire system is obtained without the usual balancer. Current in the neutral is furnished by alternating collector rings on the main generator, cables from which lead to auto-transformers back of the switchboard. The voltage between the outside leads is 230, while between the neutral and each of the outside it is 115. The bus bars of the generator switchboard are so arranged that one engine or any number of them can be run on either the lighting or the power bus bars, thus enabling the engineer to manipulate the lighting and power systems entirely independently of each other, and thereby preventing undue fluctuation in the brilliancy of the lights when loads are thrown on and off on the power end. So much of the

current received at the generator switchboard as is conveyed to the older buildings or is used for driving machinery throughout the new building, including the elevators and fans, is transmitted directly from this switchboard. All other current passes to the distribution switchboard.

The main distribution switchboard, which is situated in front of the west wall of the east wing, north of the passageway into the pavilion, receives from the generator switchboard eight cables of 500,000 circular mils, eight of 600,000 circular mils, nineteen No. 2–0, and four No. 2 lead-covered cables. This switchboard is composed of twenty-four marble panels—twelve for ceiling outlets, ten for floor and wall outlets and two for the rotunda lighting—with twelve switches of 50 ampere capacity on each panel. The switches are arranged in four lines, in the order of the several stories, the lowest representing the ground story; the next, the first story; the third, the second story; and the upper, the third story. From these switches current is carried to distribution panels throughout the building, and thence to the outlets in the ceilings, walls and floors, for the attachment of lamps and incidentally of desk fans.

Omitting the rotunda, there are in all 213 of the distribution panels, each of which is contained in a sheet iron box with steel door and trim. As a rule, they are placed in pairs set in the walls of each story, one furnishing current to the nearby ceiling lights, the other to the floor and wall receptacle outlets in the adjacent space. The panels for the ceilings have each eleven, and the others 10 switches, of 30 ampere capacity. The connection between the distribution switchboard and the panels is made by means of triple conductor cambric insulated lead-covered cables, which are carried through the tunnels under the basement floor in terra cotta conduits, and thence, through 2½-inch galvanized iron conduits, up such of the pier chases as pass close to the panels. One such cable runs from each switch on the board to one of the panels, where it is connected to the three bus bars of the panel, and the switches are so connected that five furnish current between the neutral and positive, while the other five furnish current between the neutral and negative wires. In this way the system is balanced when all the switches are thrown in with approximately no current passing through the neutral wire.

Distribution of wires and outlets.—For carrying the wires from the panels to the receptacle outlets ¾-inch galvanized iron conduits have been used. They are covered into the construction of the floors and walls and are therefore inaccessible, so, to provide for the insertion or replacement of wires, pull or junction boxes are interposed, being located in the floor, one underneath each distribution panel. The tops of these boxes consist of a brass floor flange in which a brass cover plate is secured by means of bayonet lugs pro-

vided with screw holes to facilitate its removal. The connection between each panel and the adjoining box is by means of four 1¼-inch conduits, and all outlet conduits belonging with any panel center at the box. The sizes of the wires to the outlets now installed are Nos. 12 and 14, according to their lengths. None of the conduits have been wired to their full capacity.

The receptacle outlets for the attachment of lighting fixtures are located in the ceilings, in the floors, and in the walls and inside piers a short distance above the floors. They have been provided in sufficient numbers to meet what has seemed to be all possible requirements of the future, and, while a large proportion of them will probably never be utilized, their installation and the introduction of the conduits leading to them during the construction of the building precludes the necessity for any later defacement of the walls and ceilings.

The ceiling outlets, with few exceptions, are distributed uniformly throughout the four main stories, extending in three rows through the ranges, and in two rows on each side of the wings, at the outer ends of which there are two complete crossrows. Their spacing in each row is 18½ feet, conforming to the building unit of dimension, and their location is opposite the windows. This arrangement provides a row for each of the corridors in the ground and third stories, and one for each line of rooms on one or both sides of the corridor, as the case may be. The middle wing in the ground story contains seven longitudinal rows, of which three are in the central hall and two in the series of rooms on each side. Ceiling outlets also occur in the north entrance vestibule and lobby, in the galleries of the south pavilion, and in the recessed part of the south portico back of the columns.

There is likewise a close uniformity in the distribution of the wall and floor outlets in the ground, first and second stories, which is as follows: A single outlet is located on each of the piers of the outer and court walls intervening between windows in all of these stories, and also on each of the interior piers in the ground story, with a few exceptions, as in the north entrance lobby and at the outer ends of the east and west wings. In the first and second stories, however, each interior pier is provided with two outlets, which are placed on opposite sides of the pier. In the absence of interior piers in the second story of the wings, a line of outlets is spaced 18½ feet apart along the walls of the light wells. The floor outlets occur in two longitudinal rows in the ranges, one about midway between the row of interior piers and the court wall, the other at about the same distance from the outer wall. In the wings there are two complete rows, one on each side, while in the middle or skylighted space enclosed by the piers in the first story three rows are provided, but the

outlets in these are spaced at double the unit distance, namely 37 feet, and those of adjoining rows alternate. There is also a complete crossrow at the outer ends of the east and west wings in the first and second stories. These floor outlets are all opposite the windows.

The third story contains no wall or pier outlets, but floor outlets extend in two regular rows, spaced 18½ feet apart, through each series of rooms at the sides of the corridors. The outlets in one of these rows are located close by the outer or court wall directly at the side of each window, while in the other row they occupy corresponding positions with reference to the door openings. The lighting of the attic spaces is accomplished by means of wires from panels on the third floor, which are carried through galvanized iron conduits and distributed to meet the requirements. In addition to the distribution above described, wall outlets are also located in certain dark places and on the walls of the stairs.

Two kinds of floor outlet boxes are used. Those in the ground, first and second stories are larger than the others and have a brass floor flange the same as the junction boxes, but each cover plate is drilled and tapped for four brass plugs. When connections are made as many of these plugs as necessary are replaced by special brass nozzles through which the electric cords pass. The floor outlets employed in the third story correspond with the wall and pier receptacle boxes throughout the building. The cover plates of all of these boxes are fastened to adjustable steel rims, and in the center of each a slotted flange cap is screwed. Connection is made, after the removal of the cap, by means of an outlet nozzle for holding in place the special receptacle designed to make sliding electrical contact within the boxes. All exposed parts of these fixtures are of polished or white enameled brass.

The wiring of the electric conduits has been carried only to the extent called for by the present requirements. This includes connections to all the ceiling outlets; to most of the wall and pier outlets in the east and west wings in the ground story, and to the wall outlets in the rooms at the sides of the middle wing and the ranges in the same story; to the pier outlets in the middle wing in the first story for the lighting of the picture gallery; to the floor outlets along the outer and court walls in the third story, and to the attic spaces. The wall, pier and floor outlets in the first and second stories have been provided with reference to the special lighting of exhibition cases, but the general illumination of the exhibition halls is expected to be accomplished by means of the ceiling lights.

Fixtures.—The ceiling fixtures installed in the first and second stories and in the greater part of the ground story consist of a brass chain about 3 feet long supporting an Alba glass shade specially

designed for a 100-watt tungsten lamp. The lamps used have the bowl frosted. In the third story the ceiling fixtures are made of a short piece of ⅜-inch brass tubing with a satin finish holophane shade. In the rooms 100-watt lamps are employed and in the corridors 60-watt lamps. A few of the rooms in the ground story have the same style of fixture, but with a longer stem; while for the east wing, containing the power plant, special fixtures have been made of pipe and fittings to suit the different requirements. The north entrance vestibule is lighted by two 60-watt Meridian tungsten lamps with frosted bowls that screw into a special fixture fitting close against the ceiling. The ceiling lights in the rooms are controlled by wall switches, one inside of each door, and in the corridors by switches of the same kind located in gangs at or near the end of each corridor. The control of the ceiling lights in the first and second stories is directly from the distribution panels.

The east and west skylighted halls in the first story obtain their general illumination from above the ceiling lights through the medium of special Frink skylight mirror reflectors carrying 40-watt tungsten lamps. There are sixteen lines of these reflectors over each ceiling light, being attached one on each side of the lower horizontal member of each of the eight roof trusses spanning the light well. Each line is 30 feet long, and is supplied with 32 lamps placed horizontally and connected alternately in two circuits. The 32 circuits thus constituted in each light well are controlled by as many switches contained in four panels on the walls at the pavilion end of the space.

The lighting of the picture gallery in the middle hall of the first story is also accomplished by means of Frink reflectors, consisting of long tin holders containing mirrors so placed as to reflect the light against the screens, from which the fixtures are distant about 5 feet. The lamps are 25-watt tungsten, with a few of 60-watt, spaced 1 foot apart. The aggregate length of the reflectors in the several rooms is about 750 feet.

The plans for the illumination of the rotunda have not yet been fully carried out, and the only fixtures so far permanently installed consist of ceiling lights in the corridor and gallery back of the piers and screens in the first and second stories. These are in the form of pendent alabaster glass bowls, 15½ inches in diameter, attached by means of three small chains to a larger one, the chains being of brass finished in French lacquer gilt. The bowls, which are slightly tinted to produce a somewhat subdued light, contain three outlets fitted with 60-watt clear tungsten lamps resting at a slight angle to the horizontal. Thin celluloid sheet covers prevent dust from entering the bowls.

The south approach to the building is still without fixtures, but at the north approach two 10-foot cast-iron street lamp posts, each carrying a 14-inch white glass globe with a 250-watt tungsten lamp, have been installed, one on each side of the entrance.

The desk lamps employed in the laboratories and offices are mostly of the flexible goose neck pattern, although some other simple kinds are used. The desk fans are connected with the same receptacle outlets as these lamps.

Patrol system.—For the convenience of the watchmen in making their rounds, a few widely separated ceiling lights, composing the so-called patrol system, are kept burning all night. Their control is by distinct switches, one on each of the ceiling distribution panels, connecting with four panels back of the main distribution switchboard in the ground story, and from these in turn with the patrol panel in the generator switchboard from which the patrol lights may be regulated irrespective of the general system.

Motors.—The total number of motors in the electrical equipment of the Museum is 65, of which 51 are in the new building and 14 in the other buildings. Sixteen of these, mainly connected with the operation of the elevators, and of the ventilating and engine room fans, are of 12 to 25 horse power each. The remainder range in size from $\frac{1}{6}$ to $7\frac{1}{2}$ horse power and are used for a variety of purposes.

Connections with other buildings.—The electrical connections with the older Museum and Smithsonian buildings are made from the generator switchboard through a 9-way terra cotta conduit in the underground tunnel already described. The present installation consists of two separate lines of three cables each, two of the cables in each line being of 500,000 circular mils and one of 250,000 circular mils. From the southern end of the tunnel they are carried eastward along the ceiling of the basement corridor in the Smithsonian building. One line stops at a switchboard in the eastern end of this building, while the other continues to the main switchboard in the southwest pavilion of the older Museum building.

VENTILATION

General system.—The ventilation of the building in general and of certain parts of it in particular has been provided for through mechanical agencies. In view, however, of the large open spaces characteristic of the greater part of the building, it was not considered necessary to extend the direct operation of the general system to all the stories, and it has been worked out most completely for the third story. The machinery is located in the attic spaces of the three wings and consists of powerful fans which operate to withdraw the air from the several stories, either directly through flues

or indirectly through other channels, such as the stair wells and elevator shafts, and discharge it through openings in the roof.

The space enclosed between the skylight and ceiling light in the middle of each wing and the entire attic space over both ranges serve as exhaust chambers into which the air passes on its way to the fans. There are six of these fans, of the full-house pattern made by the American Blower Company, arranged in pairs at the outer ends of the three wings and identical in all respects except that those in the east and west wings measure 6 feet, while those in the middle wing, where the height is less, measure only 5½ feet. The smaller size of the latter is, however, compensated for by giving them a maximum speed of 300 revolutions a minute, the former making only 250 revolutions. Each pair is operated electrically by a 25 horse power Diehl motor, direct connected to one of the fans which may be run singly if desired, the shafts of the two being united by a flexible clutch coupling in such manner that the other fan may readily be thrown out of service. The discharge capacity of each pair is 70,000 cubic feet of air a minute, making a total for all of 210,000 cubic feet. Each pair of fans is contained in a brick house adjoining the skylighted space at its outer end and communicating with it by means of a large rectangular opening supplied with dampers. The ranges connect with the fan houses through large ducts, while the discharge openings in the roof are above the fans, and measure 18 feet 10 inches long by 3 feet wide.

To check direct heat radiation from the roofs in summer the side and outer end sections of each of the attics in the wings are provided with false ceilings of ¼-inch Sackett board, which underlie the roof with an interspace of about 5 inches. This ceiling begins about 5 feet from the eaves and on the sides stops about 2 feet 3 inches from the walls of the skylight chamber, whence a curved galvanized iron deflector carries around the longitudinal I beams projecting below the roof in the plane of the walls, and continues the interspace until it opens into the chamber which it does throughout the entire length of the latter. The ventilating flues and ducts communicating with the attics are located in the wall chases and in the floors about 2 feet from the eaves. All of the air issuing from them and from other openings into the attics is drawn into the exhaust chambers and thence into the fan houses by way of the shallow space above the false ceiling, but with the opening of any of the hinged panes in the transoms of the third story a certain amount of air will enter the chambers directly from that source.

The low attic spaces over the ranges present wholly different conditions, and are kept entirely closed at the ends except when access is required to the pipes or wires which they contain. Into

these large vacuum chambers the air is pulled from the wall flues and floor ducts, but instead of being carried directly to the fans, it is, by an extensive system of pipes, made to assist in preventing direct heat radiation from the roofs to the third story ceilings. The arrangement is as follows: Four large galvanized iron ducts traverse the attics longitudinally, one on the east side leading to the eastern fans, one on the west side leading to the western fans, and two on the north side, both much shorter than the others, leading to the northern fans. From the place of origin, where they are relatively small and round, about 15 inches in diameter, the ducts increase gradually in size and change to a rectangular shape, becoming quite large where they reach the wings. At twelve different points in each length of 18½ feet, and placed only a few inches from the roof, are series of inlets opening into branches of varying length, connected with the main ducts and so proportioned that the amount of air drawn from all parts of the range spaces will be approximately the same, this result being accomplished by decreasing the size of the branches in the direction of the fans. The branches are, furthermore, supplied with dampers for their separate control. In this manner all of the air entering the chamber is lifted to the under surface of the roof, and thereby kept in circulation until it is withdrawn. In passing out of the ranges, each duct first opens into a large brick chamber in the adjoining wing, which is connected to the fan house across the ceiling of the wing by another large iron duct, provided with a regulating damper.

The auditorium, boiler and engine rooms, alcoholic specimen room and several toilet rooms in the ground story have each a separate ventilating system, as described below. This story has direct connection with the general fan system through flues in each alternate pier chase in the middle wing and two ranges, which were introduced principally with the object of carrying warm air to the third story to assist in its heating. The inlets, covered by 12 by 14-inch iron registers, are located a little over 2 feet above the floor. The flues have openings in both the third story and the attics, but, as they convey unpleasant odors and noxious fumes from the preservatives and poisoning materials used on the specimens stored in the ground story, it has been found necessary to keep the openings into the third story closed. They undoubtedly serve a useful purpose in those parts of the ground story from which they lead, but for the ventilation of this story dependence is mainly had upon the window openings in conjunction with the transoms of the room partitions and the registers in the bottom rails of the doors.

There is no direct connection between the first and second stories and the fan system in the attics, except through flues in certain of the pier chases with openings near the floor in the first story. These

flues, however, like those starting in the ground story of the middle wing and the ranges, have an inconsiderable influence on the ventilation of these stories, for which it was deemed unnecessary to introduce an elaborate mechanical system. Both stories are of considerable height, and circulation in each of them is unobstructed around the entire building, the few intersecting walls being pierced with especially large openings. The two stories also communicate with each other through the openings in the light wells, and with the rotunda, and have the advantage of the elevator shafts and stair wells leading to the third story and the attics. All of the windows are provided with hinged panes through which air can be directly admitted. The effect of the heat from the radiators placed under or against the great window surfaces is to maintain an active circulation in cold weather, and, judging from the experience so far gained, there is no reason to suppose that the exhibition halls will ever become uncomfortable or unwholesome from lack of ventilation. The air contents of the first story amount to about 2,166,000 cubic feet, and of the second story, to about 1,591,000 cubic feet, a liberal allowance for even the largest attendance of visitors that may be expected at any time.

The third story, however, calls for effective ventilating measures, in view of its proximity to the roofs, its relatively small rooms, the extensive collections in storage and the number of persons who work there. The numerous windows, hung with double sashes, can be opened to admit air either from the top or bottom. Above each of the entrance doors, which are opposite the windows, is a grated opening. The natural drift of the air in the corridors is toward the elevator shafts and stairways, and in the wings the hinged panes in the transoms along the upper part of the light well walls afford means for direct communication with the exhaust chambers. For mechanically withdrawing the air there is a flue in each alternate pier chase and a ceiling register opening in front of each window, or two ducts in every unit length of 18½ feet on both sides of the wings and ranges, all of which lead into the attic spaces in the manner before described.

Auditorium and rotunda.—Owing to the doubly enclosed position of the auditorium in the ground story of the south pavilion, it has been necessary to provide for its ventilation through the medium of a special system, in which the rotunda also participates. The air is drawn into the building through a window by means of a full-housed fan of the American Blower Company's make, operated by a 12 horse power Diehl motor and installed in a small room adjoining the entrance underneath the south portico. Before reaching the fan, however, it passes first through a cast-iron Utica pin radiator of the hot water type, next through an air washer, and finally through

a second heater of the same type as the first, the heaters being designed for winter use only. It is discharged from the fan into galvanized iron ducts located in the furred ceiling of the corridor surrounding the auditorium.

For ventilating the auditorium the greater part of this air is led into vertical ducts built in the walls at the northeast and northwest sides of the auditorium, which lead downward and open into the chamber under the raised floor. The distribution throughout the room is mainly by means of several hundred small elongate openings in the successive surfaces of the step-like arrangement on which the chairs are fastened. These openings, in fact, lead into metal registers incorporated in the side standards of the chairs, so that the air becomes diffused instead of rising in a mass from each opening. There is also a chamber under the speakers' platform, from which the air escapes through large registers in the front of the platform. The air is withdrawn from the auditorium through four large register openings in the ceiling connected with a flue on the west side, which extends to the attic space of the west wing and has a Blackman fan at the outlet.

In the rotunda, two branches from the main duct direct the air into flues at the southeast and southwest corners, in which are located heaters of the same type as those in the fan room, the discharge being near the ceiling of the first story through large rectangular registers. This circulation serves the double purpose of ventilation and heating. The rotunda is further heated by means of radiators similar to the above placed in flues on the north side of the rotunda near the stairs. The air enters the flues through register openings in the first story, is raised in temperature and passes out at the third story.

Alcoholic specimen room.—This room, which occupies the entire middle part of the ground story in the west wing, and measures about 130 feet long by 52 feet 11 inches wide and 18 feet 8 inches high, is furnished to nearly its full height with stacks of shelves for the storage of specimens preserved in alcohol. Being as completely isolated within the building as the auditorium, it is equally dependent on artificial agencies for its ventilation, which are required to be effectual in order to dispose of the noxious and inflammable fumes resulting from the evaporation of this preserving fluid.

Air is admitted to the room close to the floor through gratings in the bottom rails of the thirteen doors. A large galvanized iron outlet duct runs the entire length of the ceiling, from which it is suspended, on the north side of the central row of piers. Two branches enter this duct in each unit of length, one from each side, but since the southern part of the room is slightly longer than the other there are, in fact, thirteen branches in all. They are approximately 2 feet long with conical openings protected with ½-inch wire mesh, but, while the

openings are uniformly 12 inches across, the size of the outlets where they join the duct decreases in the direction of the fan, in order to effect an approximate uniformity of outflow of air from all parts of the room. Each branch is also provided with a damper. The main duct leaves the room at its northwest corner, crosses the ceiling of the adjoining corridor alongside one of the large girders, and enters a flue back of the west freight elevator, in which, at this point, there is a 2-foot Sturtevant full-housed blower fan, operated by a 1½ horse power motor. The discharge passes up the flue, which measures approximately 2 by 4 feet, and escapes through a ventilator at the roof. By this arrangement the entire body of air in the room may be changed every 47 minutes.

Toilet rooms.—The general toilet rooms are all ventilated by means of separate fans. Each of the public rooms in the ground story near the north entrance has a flue connected to the space back of the closets, giving direct ventilation from each of them, and a register for room ventilation on the wall near the ceiling, both uniting in a vertical flue leading to the attic space above. Here, on each side, a small full-housed American Blower fan driven by a ½ horse power motor discharges the air through an Emerson ventilator in the roof. The two rooms in the third story of the middle wing near the rotunda are similarly ventilated by fans of the same size and character, located immediately over each toilet, but the air, instead of passing directly through the roof, is discharged into the exhaust spaces of the attics of the east and west wings. The two rooms in the ground story of the east and west wings are each adjacent to one of the flues in the wall structure surrounding the rotunda. The fans are at the base of these flues, but, as the flues are cut off by diaphragms at the first floor level, the discharge is provided for by means of 15-inch galvanized iron ducts which run to the roof and terminate in Emerson ventilators.

Engine and boiler rooms.—For the ventilation of the engine room there are two 3-foot Blackman fans located in a galvanized iron duct, 4 feet 6 inches square, near the ceiling of the reserve coal vault at the east entrance and discharging through a grilled opening in the window between the two doors. The air is drawn over the top of the boilers through a duct at the ceiling of the adjoining corridor, measuring there 10 by 2 feet but changing in general form though not in capacity inside of the boiler room. Between and above the boilers a galvanized iron partition with a door opening into the engine room prevents the removal of any air from the boiler room itself, except through an opening in the side of the duct controlled by a damper. This arrangement gives positive ventilation to the engine room by withdrawing the air from the top of the boilers after it has entered the extreme western end of the room. Further aid to the ventilation

of this room is secured through the withdrawal of air from the top of the boilers by the fan which furnishes forced draft to the stokers. Being enclosed in a brick house, this fan can obtain air from no other source than the engine room. In practice, however, it has been found necessary to by-pass a small amount of cooler air to the stoker fan in order to prevent the excessive heating of the bearings by the extremely hot air coming from above the boilers.

MISCELLANEOUS EQUIPMENT

Fire service.—For announcing the discovery of a fire an alarm system patterned after the customary city service has been provided. The gong, 14 inches in diameter, is on the north wall of the south pavilion in the first story. Connected with it by wires and operated by Samson batteries, are nine stations located in different parts of the building, as follows: One each in the ground, third and fourth stories of the south pavilion, four in the third story of the main part of the building, and one each on the landing of the east and west service stairs between the ground and first story floors. Each station consists of an iron box with glass face, fastened on the wall, and the breaking of the glass with a small hammer attached closes the circuit and causes the ringing of the gong, which repeats the number of the station six times.

For fighting fire there are three 4-wheeled chemical engines of 50 gallons capacity each, located in the ground, third and attic stories, a very large number of hand extinguishers distributed to all parts of the building, and a complete water system. The last mentioned is connected with a Buffalo fire pump in the engine room, which measures 14 by 7 by 12 inches and is controlled by means of an automatic regulator. It is designed to furnish pressure at about 90 pounds and is kept in readiness for action at all times. The piping layout terminates in thirty 2½-inch outlets, six in each of the five stories, including the attic, in all of which they are placed at approximately equal distances apart. The equipment at each outlet consists of a 2½-inch angle hose valve, a metal swinging hose rack, and 175 to 200 feet of the best quality 2½-inch linen hose with a 12-inch long nozzle. All of the metal work is nickel-plated.

Watch clock service.—During the greater part of the night watches complete rounds of the interior of the building are made at stated periods by members of the watch force. As a precautionary measure, these rounds are checked in accordance with a system which has long been in use in the older buildings, comprising a central clock with appropriate mechanism for recording signals sent from stations in different parts of the building, all of which the watchmen are required to visit during each circuit. The central or master clock, located in the office of the captain of the watch,

is arranged to receive paper dial sheets, one for each day, on which the signals are marked by a recording point so as to indicate both time and number of station. The stations consist of boxes embedded in the walls and covered by a plate pierced with a small hole for a key, which, being inserted and turned, rotates an armature that transmits a current to the clock. The power is furnished by magnets, no batteries being required. While the clock has sufficient capacity to record from 50 stations, only 33 stations have been installed. They are distributed to the most remote parts of the building, seven being located in the ground story, six in the first story, seven in the second story, eight in the third story, and five in the attic.

Time clocks.—Time is furnished throughout the building by a series of marble clock dials, the hands of which are controlled electrically by a master clock in the office of the superintendent of construction and labor. There are sixteen of the subsidiary dials, one in each of the large exhibition halls, six in the ground story and seven in the third story. A Seth Thomas eight-day clock of superior quality, placed in the telephone exchange room and corrected at noon each day through electrical connection with the Naval Observatory in Washington, supplies the standard time by which this service is regulated.

Telephone service.—The telephone exchange for the entire Museum service is installed in a room adjoining the north entrance lobby and the office of the watch, which obviates the necessity for the presence of a regular operator after the close of business hours. The switchboard is known as the Western Electric Company's No. 4 private branch exchange, and represents the latest type of common battery equipment, with small electric lamps as signals. Its total ultimate capacity is 240 local telephones, 40 trunk lines to the central office and 30 pairs of cords, the equipment being divided between two operators' positions. Only one position has been fitted up, with provision for 120 telephones and 8 trunk lines, and a complement of 15 pairs of cords. The number of telephones actually in use is considerably less than this, however, and the number of trunk lines is limited to 5, one of which belongs to the departmental service.

The cables enter the building below ground level at the west side of the north pavilion where the exchange room is situated. They pass through the western tunnel under the middle wing to the northwest corner of the south pavilion, and thence to the attic in which they follow along the walls of the three wings. The branch station wires for the instruments in all stories run from the cables in the attic. A specially designed picture molding in the ground and third story rooms provides the means for their extension along the walls.

Vacuum cleaning.—A most important feature of the mechanical equipment is a vacuum cleaning plant, with ramifications to all parts of the building. Besides its application to the ordinary purposes of housekeeping, the usefulness of this apparatus will be especially felt in connection with the cleaning of both exhibition and storage cases, and of their contents, which has hitherto been a slow and laborious undertaking. It may be employed for many classes of objects, and with particular advantage in the removal of dust from fabrics and skins.

The plant is a stationary one. The machine, located in the engine room, is of the Blaisdell Machinery Company type, and consists of an automatic piston pump connected through a silent chain drive to a 25 horse power motor. Two large tanks are provided in which the dirt-laden air is cleansed on its way to the pump, in the first by centrifugal force, in the second by passing through water. After leaving the pump the air passes through an oil and water separator and is led into the main smoke breeching. From the mains, which run through the tunnels under the ground floor, branch pipes extend to the several stories on which the inlets, to the number of 73, are symmetrically disposed, there being 13 in the ground story, 16 each in the first, second and third stories, and 12 in the attic. The inlets are mostly located on piers about 2 feet above the floor and measure 1¼ inches, while the size of the riser pipes is 3 inches. The inlets are closed by means of brass caps with soft lead gaskets to prevent leakage. The dust hose employed is of rubber, in lengths of 25 and 50 feet, and is attached for use to the inlet nearest the place where cleaning is to be done. A complete equipment of dusting tools has been provided.

Ice plant.—For the manufacture of ice the building contains a 5-ton refrigerating machine, supplied by the Brunswick Refrigerating Company. It occupies a small room near the entrance under the south portico, and is of the compression type, being driven by a silent chain from a 7½ horse power motor. Its capacity is two tons of ice every twenty-four hours. The freezing tank measures 21 feet 8 inches by 9 feet ⅜ inch and contains fifty-four 200-pound cans. The circulation of the brine in the tank is produced by means of a ¾-inch volute pump driven by a belt from a ½ horse power motor. A hoist running on a track along two opposite walls of the room serves for the removal of the cans. A still smaller adjoining room has been adapted to the storage of ice by lining its walls and ceiling with sheet cork covered with cement plaster, and providing a suitably drained cement floor and a door of cold storage pattern.

Drinking water service.—For supplying drinking water, a number of cooling tanks have been installed in the attic with distribution pipes leading to outlets in the several stories. There are six of these

tanks, four with a capacity of about 750 pounds of ice each, and two with a capacity of about 325 pounds each. Their location is near the top of the freight elevators and of the elevators and stairway in the north pavilion, and in the attic space of the middle wing near the south pavilion. The tanks are of steel covered with cork and wood, and each contains a coil of 1½-inch galvanized iron pipe for the circulation of the water, on top of which the ice is placed. Water enters the coils from the city mains, and also by return after dropping to the ground story, the circulation being continuous. The outlets, aggregating 20 in number, terminate in spigots, set in small catch basins with waste pipes, which are embedded in the walls except a few in the third story which are set against the thin expanded metal partitions. While this service is commendable in principle, its advantages are restricted by the fact that the water cannot be carried far, especially in a horizontal direction, at a sufficiently low temperature.

Gas.—No provision has been made for the use of gas for illumination, but it has been introduced on a small scale to serve the few purposes in which a flame is required for heating, as in the mechanical shops and some of the laboratories. The main enters the building under the north pavilion where, in the battery room, a meter is installed. The distribution is through the tunnels under the ground floor and the pier chases.

WATER CONNECTIONS AND SEWERAGE

Water is brought into the building under the south doorway of the east entrance through a 6-inch pipe leading from a 12-inch city main. The 6-inch pipe enters and terminates in the boiler room, but before reaching there it is tapped by a 4-inch pipe from which nearly the entire building is served for general purposes. This principal branch diminishes in size as connections are made for supplying the toilets, basins, sinks, fire risers, etc., until it reaches a minimum of 2 inches in the extreme west side of the ground story and in the third story. The distribution of the pipes, which are of galvanized steel, is through the tunnels and pier chases. With the exception of the fire service, the city pressure is relied upon, although the service in the third story is cross-connected with the power plant to provide against an emergency.

Hot water connections with the lavatories, wash basins and slop sinks are made from the engine room. The machinery comprises a 2-inch Alberger volute pump run by a 1 horse power Westinghouse motor, from which a 1½-inch discharge passes through an Alberger hot water heater made up of copper tubes in a manner similar to the large heaters. From the heater the water is carried to a large tank

suspended from the ceiling of the engine room, and thence distributed through a system of piping in the tunnels and chases. The temperature of the water is maintained constant by means of a thermostat in the tank, which regulates the opening and closing of an automatic diaphragm valve in the pipe supplying steam to the heater.

For the disposal of sewage there is a 12-inch cast-iron pipe extending north and south through each court and under the northern ranges, and separate pipes of glazed terra cotta, 5 to 15 inches in size, around the outside of the building, all of which combine and discharge into a city sewer directly north of the north entrance. These sewers receive the soil pipes from the various plumbing installations, the downspouts from the roofs, the area drainage and the drainage from the tunnels under the ground floor. The pipes are mainly of cast iron, and vary in size from 4 to 6 inches.

INTERIOR OF THE FINISHED BUILDING, ITS ARRANGEMENT, DIMENSIONS, EQUIPMENT AND USES

GENERAL ACCOUNT

In its adaptation to the requirements of natural history collections this new structure must be accorded the foremost position among the museum buildings of the world; and despite its large size it is notable for the compactness and convenience of its arrangement. The subjects represented are wholly cared for under the same roof, and the exhibition collections, the reserve collections and the laboratories relating to each are, therefore, closely associated.

As described in the foregoing pages, the building comprises four stories which are indicated on all of the façades by as many tiers of windows, besides a certain amount of space in each wing immediately under the roofs which is also available for museum purposes. There are two public entrances, one at the middle of the north front, facing B Street, the other at the middle of the south front, facing the park or Mall. The former opens on the ground floor, the latter, which on account of its architectural position is the main entrance, on the first floor. The principal stairs and the passenger elevators are located near them, and while both are large and either would be ample for the admission of any number of persons who might be expected to visit the Museum at one time, in view of the size and arrangement of the building, there seemed to be no way of avoiding this duplication, which is mainly objectionable in that visitors depositing their umbrellas, canes and other objects at one entrance must find their way back to the same entrance on leaving. The other entrances, three in number, are all in the ground story. One under the south portico and opening into the driveway connecting the basement areas in front of the east and west wings furnishes the most direct communication with

the large vault-like compartment comprised within the masonry of the main approach. The doorways for the delivery of fuel and freight, at the outer ends of the east and west wings, respectively, are large enough to admit wagons, and adjacent to them are the freight elevators and service stairs.

In recognition of the superior claims of the public, the exhibition collections have been accorded the two principal stories, the first and second, which they wholly occupy and which contain essentially no subsidiary partition walls other than are required for carrying out the schemes of installation. A large central hall and several rooms in the ground story are also available for exhibition purposes, but otherwise this and the third story are subdivided into many compartments mostly used as laboratories and for the storage of collections, but also furnishing accommodations for the mechanical equipment, the construction and repair of furniture, the library, meetings and lectures, and the offices. The attic story is utilized entirely for the storage of specimens.

The three departments of natural history established in the building occupy space in all stories, such an arrangement being in part necessitated by the fact that no single story furnishes all of the conditions required by any department, but with the convenient means of communication the work of administering upon the collections is not appreciably hampered by this circumstance. While the extent of space allotted to each department varies in the successive stories, its distribution has been so adjusted as to locate the department of anthropology in the middle section of the building, the department of geology in the eastern section, and the department of biology in the western section. The divisions, in turn, have been assigned such positions as best suit their individual needs or tend to associate kindred subjects.

The floor and galleries of the south pavilion above the ground story furnish a large amount of space additional to that accounted for above, which is accessible to the public and may in large part be used for exhibition.

Except in the south pavilion and rotunda, the north entrance vestibule and lobby and the light wells, there has been no attempt at elaborate or decorative treatment in the finish of the interior, although the large piers and heavy ceiling girders, which characterize most of the exhibition space outside of the three main halls, add greatly to the appearance of the rooms and effectively frame the bay arrangement of cases which generally prevails. The natural lighting of the exhibition halls and, in fact, of the entire building, owing to the exceptional extent of window and skylight surface and its arrangement, is excellent, and its distribution much better than is customarily found in large museum buildings. The lighting of the

halls at night comprehends a general system and extensive provisions for introducing such direct illumination of individual exhibits as may be called for from time to time.

A modern power plant supplies the steam and electric current for heating and lighting and for operating such machinery as the building contains. There are electrical systems for recording the rounds of the watchmen and for announcing the discovery of fire. Pipes distribute water to all the floors, on each of which there are several outlets with hose attachments in constant readiness for use, while a powerful vacuum plant connected with all parts of the building forms an important adjunct for cleaning purposes.

In the furnishing of the building a great advance has been made in the matter of museum equipment, which has largely been rendered possible through the recent progress in metal workmanship. The claims so strongly set forth in some quarters in favor of the use of metal in the exhibition halls have, however, after thorough consideration, been mostly disregarded, only a few small cases with steel frames having been introduced. With the remote possibility of the occurrence of a fire in the large open spaces and its early discovery in any event, the employment of metal because of its non-combustible nature is not called for. Wood, even of the best quality, and mahogany was selected for the new building, is much more economical than metal; it lends itself more readily to artistic treatment, and the different parts of cases retain their rigidity much better, being less liable to warp and any tendency in that direction being more easily corrected.

The conditions surrounding the general and reserve collections are, however, very different, since these are kept in closed rooms and in the attic where their constant surveillance is not possible, and the cases for their storage have been mainly constructed of or covered with steel. This has not been done on the assumption that this material is completely protective, as the contrary has often been proved, but because, in proportion to the extent of its use, the chances of a fire being started or gaining headway are greatly lessened. In view of the further fact that the various storage rooms, either individually or in small suites, are entirely enclosed by fireproof walls, it would seem that every reasonable precaution had been taken to insure the safe-keeping of these, the more valuable, parts of the national collections.

A detailed account of the furnishing of the building must be left for a future report. Briefly, it may be said that, with the exception of the desks, tables, file cases, chairs, etc., used in the laboratories and offices, which are of commercial patterns, the bulk of all the furniture has of necessity been specially made to meet the various and particular needs of the Museum. In the construction of cases and

fittings generally certain basic units of dimension have been recognized, following a long established custom, which lends itself to uniformity of installation in the exhibition halls, and to a wide interchange of parts in connection with the storage of specimens. By this system of standardizing the storage drawers and shelves, as well as the cases for holding them, additions to or any rearrangement of the contents of the cases is effected with little trouble.

The two large uncovered courts enclosed by the building, each measuring 128 feet square, are intended in due time to be made accessible to the public. They have been graded and sodded, and provided with gravel walks, and in their present condition they are available for the display of such classes of large objects as are not affected by exposure to the weather. Further improvements with a view to their better adaptation to exhibition purposes are contemplated.

GROUND STORY

This story is adapted to a greater variety of purposes than any of the others. It contains the auditorium; one wing is utilized for the mechanical plant and the principal workshops; another includes a large exhibition hall, and the third the rooms assigned to shipping purposes and to the storage and distribution of supplies. Otherwise the story is mainly given over to the storage of collections, and to laboratories, preparators' workrooms and offices. The description of the story begins naturally with the north entrance, which is the one most easily reached from the cars on Pennsylvania Avenue and Ninth Street. From the vestibule, finished in gray and pink Tennessee marble, three doors open into the large lobby, the treatment of which is especially dignified and effective, the walls, piers and columns of its middle section being entirely of white marble. A large opening in the center of the south wall affords a vista through the great hall or foyer of the north wing as far as the entrance to the auditorium. In the end walls are the openings into the ranges, provided with double doors of ground glass set in bronze frames; while on the right in entering is the landing for the elevators, and on the left one of the main staircases of the building, the latter occupying the entire depth of the projection of the pavilion beyond the face of the adjoining range. The lobby is the headquarters of the watch, the room back of the elevators serving as the office of the captain, and another opening into the southeast corner as the locker and rest room for the members of the force.

East range.—This range, with a median corridor, extending from the north wing to the east wing, is typical in its subdivision. In the northern section the space contiguous to the outer wall is divided between the library and the office of buildings and labor in the proportion of two to one. On the court side three units in length are

occupied by the anthropological workshops and two by the library, the remainder being at present utilized for miscellaneous purposes. In the eastern section the entire space along the front, divided into three rooms, is used by the section of vertebrate paleontology for laboratories and storage, and the corresponding space on the court side by the division of geology for workshops and storage.

West range.—Of the two partition walls bounding the corridor in the east range only one, that on the inner side, is repeated in this range, where it also serves the purpose of enclosing a corresponding series of rooms overlooking the west court. The remainder of the range, measuring 31 feet 11 inches wide on the north side and 35 feet 4 inches wide on the west side, is open throughout its entire length of about 335 feet except for a vestibule enclosure in front of the freight elevator and the entrance to the west wing, a small compartment at the northwest corner of the range, and a room measuring 21 feet 10 inches by 20 feet 6 inches, adjoining the north entrance lobby. The latter room is used for the telephone exchange, but otherwise practically the entire range, with a floor area of 16,260 square feet, is occupied by the division of mammals, the large hall containing the main series of cases for the storage of skins, and the several rooms serving as laboratories and for the storage of the smaller specimens and of special collections.

North wing.—The principal feature of the north wing is the large central hall, extending from the north entrance lobby to the south pavilion with both of which it communicates by means of large openings. A singularly impressive effect is produced by the four longitudinal rows of massive piers, of which the two inner rows are 25 feet 2½ inches apart, leaving the median part of the hall unobstructed to that extent. The piers in these rows measure 3 feet 1⅝ inches by 3 feet 10⅝ inches, which is also the size of those in the lateral rows, but the latter enter into the construction of the side walls, from which they project only 2 feet 7 inches. Between the inner and lateral rows on each side the distance is 7 feet 3½ inches.

This hall was designed for exhibition purposes and also serves as a foyer to the auditorium, but being entirely ceiled over its only sources of natural light are the opening into the north lobby and the borrowed lights along the upper part of the side walls. Electric lamps suspended from the ceiling provide an excellent general system of illumination, which will, however, probably require to be supplemented by additional lamps at lower levels whenever collections are installed.

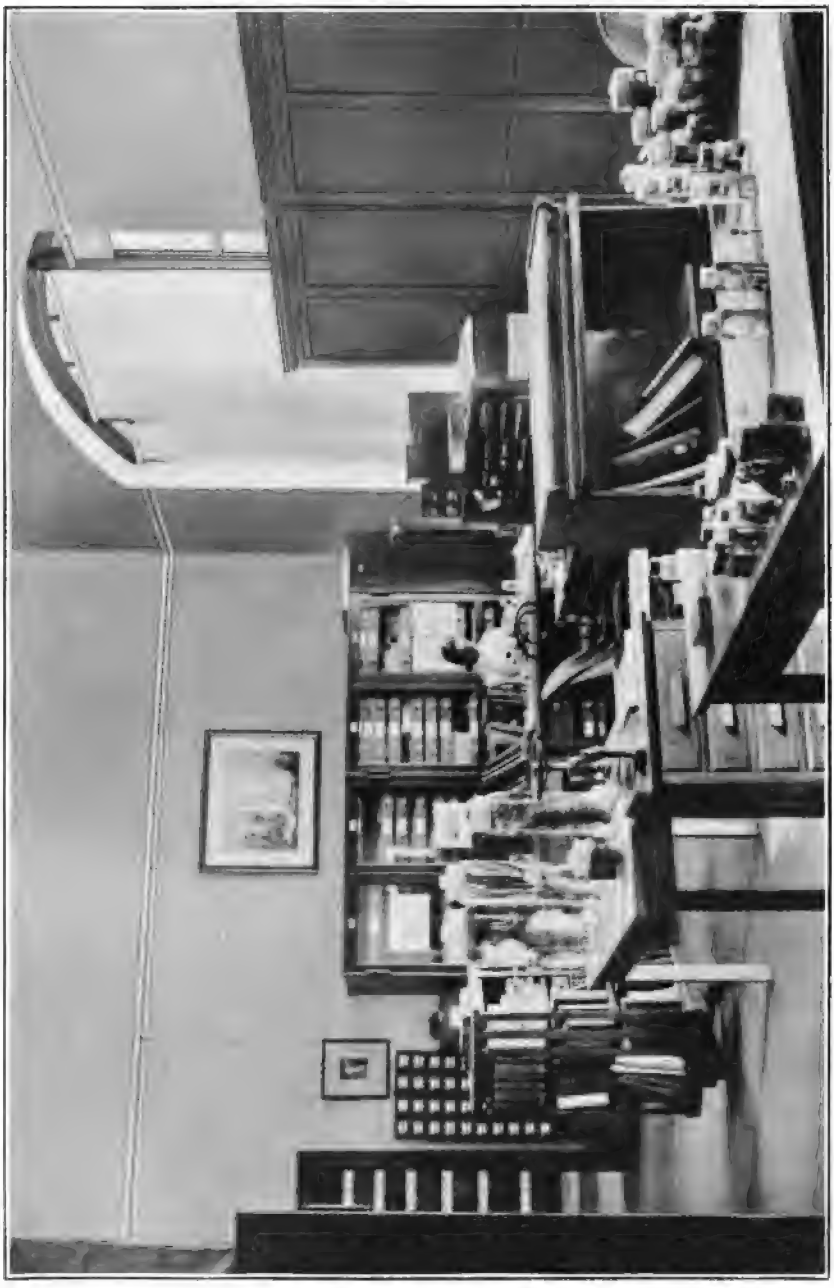
The series of rooms on each side of the central hall, facing the east and west courts, have an average width in the clear of 30 feet 5 inches, the other dimension of the several rooms varying from one to three units. The northernmost room on the east side, already

CENTRAL HALL, NORTH WING, GROUND STORY, LOOKING SOUTH.

On the sides are the rows of large piers, and back of the row on the right is seen the wall construction, with borrowed lights, separating the hall from the side rooms. In the center background is the entrance to the auditorium. (See page 104.)

EAST RANGE, GROUND STORY. LABORATORY OF FOSSIL VERTEBRATES. (SEE PAGE 103.)

WEST RANGE, GROUND STORY. STORAGE OF MAMMALS. (SEE PAGE 104.)



West Wing, Ground Story. Laboratory of Marine Invertebrates. (See page 106.)

referred to as used by the watch force, opens into the entrance lobby. All of the other rooms communicate with the central hall, the doors occurring uniformly in the middle of each of the interspaces between the attached piers except three. The public comfort and toilet rooms occupy two units on each side of the wing, and are entered by the two doors nearest the lobby. The two rooms on the west side adjoining the south pavilion, and therefore near the auditorium, are fitted up for the use of committees and for small scientific meetings, while the remaining rooms, four in number, are reserved for temporary exhibitions.

South pavilion.—From the north wing one first enters that part of the corridor in the south pavilion which has been finished as a lobby for the auditorium, and which, together with the auditorium, has been described in a previous connection. Beyond the steel doors at the ends of this lobby, the continuation of the corridor, which is but plainly finished, gives access to the east and west wings by openings 10 feet wide by 12 feet 4 inches high, and to the driveway whence the large vault under the south approach is reached. This vault furnishes a floor area of about 2,225 square feet suitable for the storage of supplies. The tower stairs and south passenger elevators have their lower landings on this floor, while the four rooms contained in the south projection and one at the side are utilized for the manufacture and storage of ice, for one of the large fans of the ventilating system, and for housekeeping purposes.

East wing.—The description of the east wing in connection with the mechanical equipment of the building leaves little to be said here. The boiler and engine rooms occupy the middle of the wing, and are followed at the inner or western end by the large generator and distribution switchboards. The suite of four rooms on the court side comprises the office of the engineer and the machine and plumbing shops. The wider series of rooms along the south front, with the exception of one enclosure used for toilet purposes, constitutes the construction and repair shops for furniture, etc. The coal bunker is at the northeast corner of the wing. Adjoining it on the side is the wagon drive for the delivery of fuel, with a depth of 41 feet 2 inches from the entrance and a width of 19 feet 3¼ inches. It is followed at the end of the wing by a large compartment originally intended and equipped as a reserve coal bunker, but now used for the storage of building supplies. Between this room and the front of the boiler room is a corridor 18 feet 1½ inches wide, giving access to the carpenter shops.

The construction shops, four in number, which occupy nearly the entire south side of the wing, are fitted up for the building and repair of furniture and for work connected with the maintenance and repair of the building. They are enclosed on the north side by a continuous

partition which in the part adjoining the engine room is provided with high fixed transom lights of heavy wired glass. Beginning at the east, the rooms consist of a paint shop measuring 32 feet by 47 feet, a cabinet shop, 30 feet 6 inches by 70 feet 10 inches, a carpenter machine shop, 33 feet 6 inches by 55 feet, and a metal shop, 33 feet 6 inches by 16 feet 7 inches. To permit of the moving of large pieces of furniture, the partitions separating these rooms have been provided with door openings 8 feet wide by 10 feet high, which is also the size of the opening into the corridor in front of the boiler room.

These shops are excellently well equipped and contain facilities for producing the highest grade of cabinet construction as well as for such other kinds of work as can be done most advantageously by the Museum force. The outfit of woodworking machinery, all of which is operated by individual electric motors, thus obviating the use of belts, includes a drill press, saw bench, variety molder, lathe, swing cut-off saw, band saw, mortise machine, tenon machine, surface planer, and oil stone and edge tool grinder.

Adjoining the toilet and locker room in the southwest corner of the wing is a shower bath and dressing room.

West wing.—The entire central part of this wing is occupied by the large compartment for the storage of alcoholic specimens, the southern half of which is several feet longer than the northern, owing to an offset in its eastern wall. On the northern and southern sides of the wing, separated from the compartment by 10-foot corridors enclosed and provided with steel doors at their outer ends, are two series of rooms used as laboratories for the subjects represented by the collections for which these storage quarters were erected. The first of these series, measuring 19 feet 3 inches wide in the clear and subdivided into three laboratory rooms for fishes, faces the west court and extends a distance of five units from the men's toilet and locker rooms in the northeast corner of the wing. It is followed on the west by a large open space, in which is located the machinery for operating the freight elevator on this side of the building. The other series occupies eight units along the south front, commencing at the south pavilion, has an inside width of 19 feet 7 inches and is subdivided into five rooms, two of which are used by the division of reptiles and batrachians and three by the division of marine invertebrates.

Both corners at the outer end of the wing are enclosed to form two large rooms, each with interior dimensions of about 47 by 28 feet. The southern room is the office for property and supplies and contains extensive storage facilities for articles of small size; while the northern room is the shipping and registration office. They are separated by the wagon drive, the floor of which, paved with vitrified

brick, is at the same level as the outside driveway, or 3 feet below that of the basement floor. Entrance is by means of two large doorways in the west wall, between which is a window of the typical basement size. The depressed area is 50 feet 11 inches wide by 41 feet 2 inches deep. There is a narrow platform on each side, and a broad one in front extending to the end wall of the alcoholic specimen room, a distance of 23 feet 10 inches, and provided with large weighing scales. These platforms are but parts of the basement floor, and in conjunction with the wide corridors in front of the shipping and property offices, furnish ample and excellent facilities for the delivery and handling of equipment and specimens.

Alcoholic specimen room.—The matter of providing suitable and adequate accommodations for the storage of the collections of specimens preserved in alcohol, which are already very large and are constantly being added to, furnished one of the more perplexing problems connected with the planning of the new building. On account of the inflammable nature of this preservative and the rapidity with which the atmosphere in a confined space may become charged with its fumes, it was hoped that the funds would permit of the erection of a separate structure for this exclusive purpose even if it amounted to no more than a series of vaults in the bank facing the south front of the building. Failing in this, it became necessary to look to the building itself, and the arrangements which have been carried out in the central part of the basement of the west wing have resulted much more satisfactorily than had been anticipated. In the large compartment, the outlines of which have already been given, there is ample space for the present and the immediate future. The storage facilities are simple, compact and convenient. No heating pipes have been admitted, and even the odor of alcohol is practically dissipated by the effective system of ventilation that has been introduced. The lighting is entirely by electricity, and every element of danger that might be associated with such a vast quantity of alcohol that is here brought together seems to have been wholly eliminated. It is to be understood that this compartment is simply a storehouse, though providing facilities for cleaning the containers, for replenishing the preservative and for the manual work of overhauling collections.

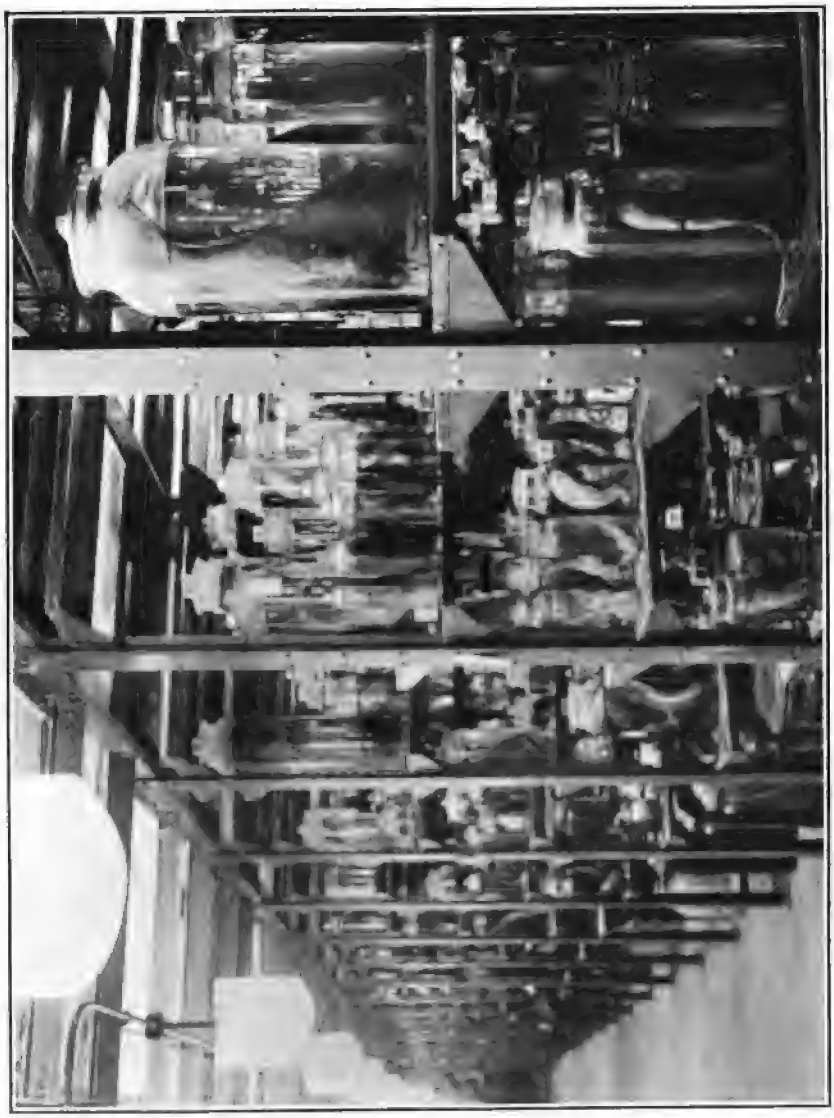
The outer walls of the compartment are constructed of brick, are 9½ inches thick, including the outer plastered surface, the inner surface as well as the enclosed piers being simply painted, and extend from the floor to the ceiling without other piercings than the door openings. The compartment measures in the clear 52 feet 11 inches wide; 121 feet ⅞ inch long in the northern half, and 130 feet 3½ inches long in the southern half; and 18 feet 8 inches high to the soffits of the ceiling arches. One lengthwise partition ex-

tending through the middle, and one cross partition on each side, all of macite 4 inches thick and reaching from the floor to the ceiling, subdivide it into four rooms of unequal size, the subjects to which each is mainly allotted and their measurements being as follows: Reptiles and batrachians, 55 feet 9 inches by 26 feet 3½ inches; fishes, 102 feet by 26 feet 3½ inches; marine invertebrates generally, 74 feet 2½ inches by 26 feet 3½ inches; and mollusks, 18 feet 9 inches by 26 feet 3½ inches. The total available area is therefore 6,591 square feet and 115,342 cubic feet, the compartment having been rendered serviceable to a height of 17 feet 6 inches.

The door openings are typical in size and position, measuring 3 feet 6 inches wide by 7 feet high, and occur midway between the piers throughout the length of the side walls and therefore directly opposite the openings into the laboratories across the corridors. The end walls, however, are not pierced. The doors are also of the typical pattern, constructed of molded pressed steel, with a cast-iron register of the width of the panel and 6 inches high in the lower rail. These registers constitute the only openings into the rooms when the doors are closed and have therefore a close relationship with the ventilation of the compartment as described in the section on the ventilation of the building. The air is removed near the ceiling through as many outlets as there are doors, each of these outlets communicating with a common duct leading to a vertical flue which terminates at the roof. Through the agency of a fan located at the base of the flue, which operates to withdraw the air, the air of the compartment is expected to be completely changed or renewed once in about every 47 minutes.

The compartment has been furnished in a manner unique for the purpose, following in a general way the plan of the library bookstack, which offers opportunity for a more compact arrangement and a more complete utilization of the space than is obtainable by any other method. The scheme comprehends tiers of adjustable shelving attached to vertical frames and separated by narrow passageways. The construction is entirely of steel, and in order to take advantage of the entire height of the compartment an intermediate or mezzanine floor has been introduced at a height of 8 feet.

The stacks may be termed single or double, according to whether they provide for shelving on one or both sides. The single stacks are those built against the walls, all of which are so occupied except the far inner wall in the room used for reptiles and batrachians and such parts of the surface of the outer walls as were specifically required for other purposes. The double stacks extend north and south or crosswise of the rooms, and have passageways on both sides. In the reptile room these stacks abut against the longitudinal macite partition, and the interspaces, measured between the outer edges of the shelves, are 3 feet wide. In the other rooms, however, only those stacks



ALCOHOLIC SPECIMEN ROOM, MIDDLE PART OF GROUND STORY, WEST WING.

View down one of the main passages, showing arrangement of the steel stacks and shelves, and under side of the mezzanine floor. (See page 107.)

extend through which are on a line with the inner large brick piers to which they are joined, the intervening ones stopping 3 feet short of the single stacks against the macite partition, but all other passageways are 2 feet 6 inches wide. A unit bay arrangement is thereby carried out, the circulation being complete within each bay, but in going from one bay to another it is necessary to return to the main passageway adjacent to the outer walls. All of the double stacks on each side of the compartment terminate at the outer end on the same line, but the width of the main aisle varies from 3 feet in front of the piers to 4 feet between them where single stacks occur.

The form of stack adopted is distinguished by the fact that, whether single or double, the shelving, which is of the bracket type, is supported from single rows of uprights, making the adjustment of shelves especially convenient and resulting in a considerable gain in the amount of shelf space available. The uprights measure 17 feet 6 inches high. Those at the ends of all stacks are of angle irons, while the intermediate ones are of T irons, the measurements of both being the same, namely 2 inches by 2 inches by $\frac{1}{4}$ inch. In the single stacks single irons are used, but in the double stacks each upright consists of two such irons, spaced 1 inch apart at the ends of stacks and $\frac{1}{2}$ inch apart at intermediate points, and secured together. The uprights are fastened to the floor by means of iron shoes, while at the top they are braced between the ceiling girders by channel irons and between the walls by tie bars.

On the side facing the passageway each of the uprights throughout its entire height, except for the 6 inches occupied by the mezzanine floor, is pierced with a continuous line of holes, each $\frac{7}{8}$ inch long by $\frac{3}{8}$ inch wide and spaced $1\frac{1}{2}$ inches on centers, which is the minimum dimension for the adjustment of shelves. The brackets, to which the shelves are attached, are triangular and consist of a solid piece of 12-gauge steel, provided on the back edge with a hook at the top and a point at the bottom both of which engage the holes in the upright. The shelves are of three widths, 12 inches, 16 inches and 18 inches, and vary in length from $20\frac{1}{4}$ inches to $53\frac{3}{4}$ inches. They are made of 14-gauge steel plate, and all 16 and 18-inch shelves, as well as all 12-inch shelves over 37 inches long, are reenforced their entire length with a $\frac{3}{4}$ by $1\frac{1}{8}$-inch channel iron riveted in the middle of the under side. As an additional means of strengthening the shelves, their front edges are turned down in the form of a flange, 1 inch wide, which serves for the attachment of labels, and the edges at the back are bent up to provide a stop, 1 inch high, which prevents the jars or bottles being pushed from the shelf.

The mezzanine floor is constructed of black slate, 1 inch thick, set in a steel framing which is attached to the walls and to the uprights of the stacks. The under side of the steel beams is 8 feet above the

ground floor, while the height of the uprights of the stacks above the slate floor is 9 feet 1½ inches. Around the stacks the mezzanine floor is edged with a curb of 2 by 2-inch angle iron at a distance of 2 inches from the front of the bottom shelf in each stack, this interspace aiding in the circulation of air between the two stories.

The provisions for reaching the mezzanine floor consist of an elevator in each of the enclosures and a flight of stairs in each except that occupied by the division of mollusks, where the space is insufficient to permit of the introduction of both means of communication. All are located against the outer wall, adjoining door openings. The elevators are operated by hand, and are of simple steel frame construction with the platform measuring 4 feet 4½ inches by 2 feet 5¼ inches. They are thus of a size to accommodate the 36 by 18-inch trucks which are used for carrying the bottles, jars and tanks of alcoholic specimens between the laboratories and the storage rooms, and through the passageways between the stacks. The stairs are entirely of steel and of plain, openwork construction, but, on account of the restricted space available for the purpose, it has been necessary to build them steep and ladderlike. Each of the three larger rooms also contains a large soapstone sink with running water.

The shelves are finished in baked enamel of an olive green color, while all the other steel work in the compartment, including that of the stacks, the mezzanine floor, the stairs and elevators, are painted the same color. The under side of the slate in the mezzanine floor is painted white, and the upper surface is oiled to keep the dust laid.

The capacity of the storage compartment cannot be computed with any degree of definiteness on account of the varying character and sizes of the containers in which the alcoholic specimens are preserved. The larger and heavier receptacles, such as tanks, are kept on the floor at the base of the stacks, but jars of considerable size may be stored on the shelves at any convenient height. It has been stated that the shelves are of three widths. The 12-inch shelves are used only in the double stacks which contain no other widths. The 16-inch shelves are peculiar to the stacks along the two sides of the longitudinal macite partition, and the 18-inch shelves to those at the ends of the rooms and along the outer walls. With an allowance of 12 inches for the average height of the interspaces between shelves, seven shelves may be accommodated below the mezzanine floor and eight above, a total of fifteen, not counting the ground floor space below the lower shelf. On this basis the stack capacity is equivalent to 27,180 lineal feet of 12-inch shelving, 2,250 feet of 16-inch shelving, and 2,520 feet of 18-inch shelving, or a total of 31,950 lineal and 33,960 square feet of shelf surface. The present installation, which is somewhat less, is as follows: Of 12-inch shelving, 22,920½ lineal feet; of 16-inch shelving, 1,959

lineal feet; and of 18-inch shelving, 1,989 lineal feet; a total of 26,868½ lineal and 28,516 square feet of shelf surface. While the present shelf space seems quite fully occupied, it is improbable that the capacity of the compartment will be overtaxed for some years. The load capacity of the shelves, as determined by actual tests, is about 155 pounds to the square foot, which is sufficiently in excess of any weight they will be called upon to carry to leave a good margin of safety.

For the lighting of the alcoholic compartment, which is wholly dependent upon artificial means, a simple but effective electric system has been provided. The wires are run in ½-inch loricated electro ducts or pipes, which are carried, uncovered, about the room, connecting the switches with the receptacle outlets. The outlets are mostly dropped a short distance from the ceiling in both stories, and are supplied with Benjamin two-light tungsten clusters, with the idea that, generally, only one lamp will be used directly in each cluster, leaving the other socket for an attachment plug with extension cord and lamp which can be carried or moved about the shelving. The distribution of the outlets is through the aisles along the outer and inner walls, and in the passageways between the stacks, there being one outlet in each of the latter.

The lighting is controlled separately in the two stories, and also separately for each bay or length unit. The switches are all conveniently placed on the inner surface of the outer walls. For the lower floor there is a switch on the entrance side of each door, which controls the lights in the corresponding bay. On the second floor there is, in addition to the general system, a patrol system, consisting of one lamp in each bay along the outer corridor, the switches for which are directly at the top of the stairs and elevators. The object of the patrol system is to furnish some light as soon as one reaches the upper floor, which has not the advantage of the door openings possessed by the lower floor.

FIRST STORY AND SOUTH PAVILION

South pavilion and rotunda.—While the first story may be reached as readily by means of the stairs and elevators leading from the north entrance in the ground story, the logical approach is from the south or park side by way of the large opening within the portico at the head of the double flight of broad granite steps. Passing through the small bronze, marble and glass vestibule inside of the heavy iron grilles at this, the main, entrance, one finds himself on the main floor of the south pavilion and rotunda, which is virtually the center of communication for all parts of the building. As described elsewhere, the space enclosed in this prominent architectural feature is of large

dimensions, and, despite the many structural and elaborative details, the plan is simple and the treatment harmonious and effective. The contrast between the massive piers and the light, open screens is marked but pleasing, the latter, serving as a decorative relief for the plain walls back of them, disclosing the positions of the several stories and the relations of the pavilion to the wings, while the openings in the piers locate the stairs and elevators, by which the successive galleries are reached and the general circulation is directed.

The total amount of open floor space furnished by the south pavilion is 22,327 square feet, of which 9,873 square feet are on the main floor, including the area within the rotunda and the corridor surrounding it. Each of the galleries contains 3,875 square feet, to which in the third gallery should be added the open space of 829 square feet adjoining the large semicircular window on the south. Practically all of this space belongs to the public, and to a considerable extent it is available for exhibition purposes, but in what manner and for what subjects it may be utilized remains for future consideration.

Wings.—Of the three openings from the pavilion into each of the wings on the main floor, one is central and leads into the skylighted area, while the others are lateral and lead into the side aisles. The east and west wings are identical in all respects; the north wing differs from them in being somewhat shorter and in possessing certain features at the outer end which are peculiar to it.

The width of the skylighted area, measured between the inner faces of the piers of the lateral rows, is the same in all the wings, namely, 49 feet 5 inches. The length of this area, from the face of the pavilion wall to the inner face of the piers of the outer crossrow, is 167 feet 5¼ inches in the east and west wings, and a few inches greater in the north wing. The width of the side aisles, including the 2-foot thickness of the piers, is about 33 feet 4 inches on the south side and 33 feet on the court side of the east and west wings, and 33 feet 1 inch on both sides of the north wing.

The space beyond the light well at the outer ends of the east and west wings is much wider than the side aisles, measuring 48 feet 6½ inches from the inner face of the piers of the crossrow to the end wall, in which the window arrangement is the same as on the south front. Along the north side of these wings where they are joined by the ranges, and including the extension of the wings beyond the range fronts, a total distance of over 90 feet, there are no windows, a condition which is repeated in all the stories, but, nevertheless, there is no part of the adjacent area which is not sufficiently well lighted for exhibition purposes.

In the north wing, the projection beyond the line of the north front of the ranges is occupied on one side by the square stair case

and on the other by an enclosure of corresponding size, containing the passenger elevators and a room behind them. The intervening space, lighted by the three large windows over the north entrance and measuring 70 feet long by 15 feet 9½ inches wide, is screened off from the main part of the wing by a terra cotta wall, 23 inches thick, with three piercings all of which are 14 feet 4¾ inches high, the middle one being 11 feet 3 inches wide, and each of the side ones, 9 feet 8 inches wide. Between this wall and the adjacent crossrow of piers is a passageway 17 feet 3 inches wide.

In each of the wings the skylighted area has been mostly screened from the aisles, so that the former is almost entirely illuminated from above, while the latter receive nearly all of their light from the windows. By this means additional wall space has also been obtained and definite boundaries have been established for the installation of different classes of exhibits. The introduction of these screens has, moreover, tended to improve the appearance of the interior of the wings by virtually carrying down the walls of the light wells to the floor level and thereby separating the high central area, as a great hall, from its relatively low-ceilinged surroundings. From the manner of their construction, however, the vastness of the space enclosed in each wing is in evidence from nearly every point of view.

In the east and west wings the screens consist of plastered walls built between the piers of the lateral rows and reaching from the floor to the longitudinal ceiling girders which span the piers. They are therefore confined to the sides of the skylighted area, but do not extend its entire length, since on each side the interspace between the pavilion wall and the first pier and that between the end piers of the side row and the crossrow have been left open, partly for appearance sake and partly to provide for greater freedom of circulation. In the east wing the screens are built of brick and are 10 inches thick, the attached piers, 3 feet wide, projecting about 7 inches on the inner faces. Measured with reference to these screens, the width of the central hall is approximately 50 feet 6 inches, of the north aisle, 31 feet 8 inches, and of the south aisle, 31 feet 11 inches. In the west wing the walls are of reenforced macite and only 4½ inches thick, and the width of the central hall is increased to 52 feet 5 inches with the piers projecting 18¼ inches, while that of the north aisle is reduced to 31 feet 2 inches, and of the south aisle to 31 feet 6 inches.

Picture gallery.—To provide accommodations for the hanging of the paintings of the National Gallery of Art, the screening of the central part of the north wing has been carried out in an entirely different manner from that above described. The space enclosed is somewhat longer and narrower, and is also completely surrounded except for the entrance openings. This results from the fact that,

while the passageway adjoining the pavilion retains the same width as in the other wings, the screen walls, which do not reach to the ceiling, extend to the outer end of the skylighted area, are built against the inner faces of the piers, and return at both ends. For the purpose of increasing the amount of wall space in this general enclosure, which measures 146 feet long by 48 feet wide, it is subdivided by walls of the same character and height into eight rooms symmetrically disposed, besides three short sections of corridor running with the longitudinal axis of the hall. The largest of the rooms is midway of the enclosure and occupies its entire width, measuring 48 feet by 36 feet. Immediately adjoining it both to the north and south is a pair of rooms, the rooms in each pair being separated by a 12-foot corridor and all having the same dimensions, namely, 36 feet by 18 feet. The southern end of the enclosure consists of a single room, 48 feet by 18 feet; and the northern of two small rooms, each 17½ feet by 14½ feet, separated by a corridor 18 feet wide. The enclosure is entered from the north and south only, and each of the rooms, except the two smallest ones, has two openings without doors, permitting the free circulation of visitors. The corridors are finished and utilized in the same manner as the rooms.

The screen walls are built with a core of 3-inch macite blocks strengthened by iron bars and covered with wood as the most suitable medium for the hanging of pictures. Measuring only 13 feet 11 inches high, an open space of 3 feet occurs between the top of the enclosing walls and the under surface of the ceiling girders which span the piers. All wall surfaces within the enclosure have a 6-inch base of pink Tennessee marble, surmounted by a wood base of the same height, and followed by a molded wainscot rail 3 feet above the floor. All of the compartments except the south room and the corridors are also provided with a 2½-inch round handrail of oak at the same height as the wainscot rail, and about 2 feet from the wall, supported on ornamental cast-iron brackets. With the exception of the handrail, all exposed woodwork, including the trims of the doorways and the molding along the tops of the screens, is of cypress.

The surface for the hanging of paintings measures 10½ feet high from the wainscot rail to the top molding, and has a total linear extent, excluding openings, of about 950 feet. It is covered with burlap, as is also the space between the baseboard and the wainscot rail, the color of this material being dark green in the rooms and light brown in the corridors. The outer surface of the enclosing wall, covered with the lighter color of burlap, is used for paintings at the north and south ends, but along the sides it is mainly occupied by cases for ethnological subjects.

Notwithstanding that the skylight over this hall was designed for lighting a different class of objects than paintings, it has given gen-

CENTRAL HALL, NORTH WING, FIRST STORY.

Looking into the screen wall inclosure used for the paintings of the National Gallery of Art. The walls of the light well and the ceiling light are seen above. (See page 113.)

EAST RANGE, FIRST STORY.

Showing single row of piers and windows on both sides. Exhibition of ethnology. (See page 115.)

ONE OF THE SIDE HALLS, SECOND STORY, EAST WING.

On the left is a section of light well wall with two balcony openings. Exhibition of minerals and gems. (See page 116.)

eral satisfaction, although some parts of the enclosure, and especially of the smaller rooms, are not as well illuminated as they should be. During bright weather, however, it is necessary to make use of a series of muslin curtains which are arranged between the skylight and the ceiling light. For night lighting there is a very complete system of Frink reflectors carrying electric lamps, as described in connection with the electrical equipment of the building.

Ranges.—The two ranges are alike in all particulars and present a continuous floor space adapted to exhibition purposes, which is unobstructed except by the enclosures for the freight elevators and service stairs and by the single row of pilastered piers, 2 feet 2 inches square. The latter are centered at a distance of about 17 feet 5 inches from the court walls, thus permitting, in the installation of cases, of the formation of aisles through the middle of each range. The width of the ranges in the clear is 54 feet 2 inches, while the extreme length of each is 316 feet 10 inches. Communication with the east and west wings is by means of two large openings, and with the middle wing by three such openings.

Division of space, arrangement of installations.—The first floor, exclusive of the south pavilion, furnishes 106,266 square feet of exhibition space which is shared almost equally by the three departments of anthropology, biology and geology. The north wing, with the exception of the space assigned to the picture gallery, and the northern section of both ranges are occupied by the division of ethnology. The west wing and adjoining section of the west range are allotted to the mammals and birds; while the east wing is devoted to paleontology, and the adjoining section of the east range to physical and chemical geology.

While no fixed rules have or could be followed in the installation of the exhibition halls, since the arrangement of the cases has depended largely on their shapes and sizes as governed by the nature of their contents, the general layout in the window-lighted spaces has been in a manner to form bays, each disposed about a single window. There are, however, many departures from this plan. Long upright cases, facing the windows, have been built against some of the screen and light well walls, while in the skylighted areas, in which objects of large size predominate, the distribution of the exhibits conforms in the main to individual requirements in the matter of space and position.

SECOND STORY

In the second story the ranges present the same arrangements and furnish the same amount of floor space as in the first story. In the wings, however, while the general dimensions correspond with those in the first story, the amount of floor space is greatly reduced by the

piercings for the light wells, the enclosing walls of which contain the structural columns and present a flush surface broken only by the several balcony openings overlooking the central halls. Each of the wings in this story contains, therefore, two elongate halls, one on each side of the light well, communicating with the first gallery in the pavilion by means of a large doorway, and opening into the space at the outer end of the wing, which, in the east and west wings, takes the shape of a shorter but broader hall.

In the east and west wings the side halls have a length of about 169 feet 6 inches and an average width of about 31 feet 3 inches, being between 3 and 4 inches wider on the south side than on the court side. The end halls are 116 feet 2 inches long, which is the width of the wing, and 46 feet 6 inches wide. In the north wing the side halls measure 170 feet 5 inches by 31 feet 1 inch. The outer end of the wing is subdivided as in the story below, the north pavilion containing the staircase on one side and the elevator shaft and small room on the other, while the intervening space adjoining the large windows, and measuring 70 feet 1 inch long by 15 feet 8 inches wide, is enclosed in front by a screen wall 21½ inches thick. This wall, separated from the end of the light well enclosure by a passageway about 17 feet 3 inches wide, has five openings 13 feet 10 inches high, the middle one being 11 feet 2½ inches wide, those next following on each side, 9 feet 8 inches, and the lateral ones, 5 feet 7½ inches. It is, moreover, joined at right angles by a continuation of each of the side walls of the light wells, with piercings 15 feet 3 inches high and 13 feet 7½ inches wide.

The amount of exhibition space afforded by the second story in the wings and ranges is 79,028 square feet, of which 30,467 feet are used by the department of anthropology, 32,634 feet by the department of biology, and 15,927 by the department of geology. The anthropological collections, which occupy the north wing and east range, are illustrative of American and Old World archeology; the biological collections, installed in the west wing and west range, include the reptiles, fishes, invertebrates and the osteological and special exhibits; and the geological collections, contained in the east wing, comprise the minerals and gems and the building and other useful stones.

THIRD STORY

The floor layout in the third story co
second story and the aggregate amou
same, notwithstanding certain varia
For instance, while the walls of
the second story, their thickne
inches, and the width of the

EAST WING, THIRD STORY.
Laboratory of fossil invertebrates. (See page 117.)

NORTH END OF NORTH WING, THIRD STORY.

Showing use of wide hall for storage purposes. The cases, drawers, and removable fronts are entirely of steel. (See page 117.)

EAST RANGE THIRD STORY.

Showing use of 10-foot corridor for storage cases. The construction is of steel. (See page 117.)

ATTIC STORY OF WEST WING.

Showing false ceiling of Sackett board, intermediate truss members, and arrangement of storage cases and shelves. The cases are steel covered and the shelves entirely of metal. The windows on the left are in the walls of the light well between the skylight and the ceiling light. (See page 118.)

is increased to the extent of the difference. On the other hand, the terra cotta furring introduced against the sloping mansards reduces the width of the ranges by 2 feet 4 inches. The only detached piers are the two at the outer ends of the east and west wings, and the single one at each corner of the ranges, the others, all confined to the wings, being attached to the walls of the light wells, from which they project 17 inches, their width being 23 inches.

This story is used almost entirely for laboratories and the storage of reserve collections, but contains the principal business offices. It is subdivided in accordance with the typical plan, as described elsewhere, and is exceptionally well lighted, containing scarcely any dark spaces and none that is not serviceable. All of the rooms, except closets, have one or more windows or double windows, according to their length, while the corridors receive light in abundance from the glass panels in the doors, the transoms above the doors and the borrowed lights in the walls of the light wells, besides the window at the northern end of the north and south corridor in each range.

The assignments of space are approximately as follows: The east wing is mostly occupied by the department of geology, including the office of the head curator, the divisions of systematic and applied geology and mineralogy, and a part of the collections of fossil invertebrates, but also contains the office of the head curator of biology. The division of paleontology is continued into the east range, the entire eastern section of which is used for fossil invertebrates and fossil plants.

The department of anthropology begins in the northern section of the east range, which contains the divisions of physical anthropology, ethnology and historic archeology; and in the north wing it occupies the rooms at the north end as offices and nearly the entire eastern side for the division of prehistoric archeology. In this wing, adjoining the south pavilion on each side, are the comfort and toilet rooms and the main housekeeping rooms for the third story, and on the west side is a suite of rooms designed for restaurant purposes.

In the west wing the rooms along the south front are used for business offices, while two large rooms at the end of the wing and the entire space between the light well and the court wall are occupied by the division of birds. The western section of the west range is entirely devoted to the division of mollusks, and the northern section, with the exception of two small rooms adjoining the middle wing, to the division of insects.

As the width of the corridors may seem unnecessarily great, it should be explained that no part of this space is to be regarded as wasted, since the installation of storage cases along the sides was contemplated in the plans, and it has already become necessary to make use of them to some extent in this manner. In fact, by this arrange-

ment, a greater amount of storage space has been secured than would have been the case had the corridors been made narrower and the room widths increased proportionally.

ATTIC STORY

In the attic story the wing sections only are accessible for museum purposes. They have the same distribution of floor space as the wings in the third story, practically all of which, with the exception of such parts as are occupied by the enclosures of the ventilating system, is available for use. The lighting in the main is excellent and well diffused, being furnished by the continuous series of windows in the side walls of the light wells. The ventilation is also good, being more direct than in the lower stories, and the false ceiling of Sackett board tends to mitigate the direct effect of the sun's rays on the roof. These conditions make the attic more habitable than such places generally are, and add to its utility for storage the advantages and conveniences required for the handling and sorting and even for the examination of collections.

The walls of the light wells are only 3½ inches thick and their faces, as in the third story, are subdivided into uniform panels or bays by attached piers. The spaces at the sides average about 33 feet 1 inch wide, while those at the ends measure 48 feet 2 inches wide in the east and west wings, and 36 feet 6 inches wide in the north wing. The height of the story to the under side of the false ceiling is about 9 feet at the sides of the light wells and about 8 feet 5 inches at the outer edge of the decked portion of the roof. Intermediate members of the roof trusses, in the form of an open framework corresponding to each truss, extend crosswise of the spaces at intervals of 18½ feet, measured between centers, and divide them into regular sections, leaving, however, an unobstructed thoroughfare, about 6 feet wide, adjoining the sides of the light wells.

Each of the wings communicates with the third gallery of the south pavilion by means of a large opening on each side, provided with double steel doors. The freight elevators, the southern passenger elevators and the tower stairs all extend to this story, which is also reached by four service stairs from the third story, two located in the north wing and one each in the east and west wings.

The total amount of floor space in the attic story, not including the south pavilion, is about 48,436 square feet, from which about 2,819 square feet should be deducted on account of the ventilating enclosures, the stairs and the elevators. The truss members must also be taken into account, and to a certain extent the heating mains, though these are mostly raised some distance above the floor. In view of the isolation of the wings and of their height above the ground, which greatly diminishes the annoyance from dust, it has not

been considered necessary to subdivide the sections into rooms, and only four enclosures, all with macite walls, have been built. One is in the north wing and three are in the west wing. Otherwise the storage cases and racks are for the most part compactly arranged in the bays formed by the truss members, and are reached from the thoroughfares along the light wells.

Each of the departments has been given the entire occupancy of a wing, the eastern being assigned to geology, the northern to anthropology, and the western to biology.

INTERIOR MEASUREMENTS OF THE BUILDING

The dimensions given on the following pages are based mainly on actual measurements of the finished building and are exclusive of all structural walls whatever their position. The size of each wing and range, for instance, has been calculated separately and in the clear between its side walls and its end walls, and the same rule has been followed in accounting severally for the measurements of the three sections into which the ground story of the north wing has been subdivided by the structural walls near its northern end, namely, the vestibule, lobby and main body of the wing, and also for the dimensions of the many enclosures contained within the structural walls of the south pavilion. That is to say, the figures recorded are designed to set forth the amount of available space furnished by the building in whole or in part, which is, however, strictly true only in so far as the space is not subdivided by subsidiary screen and partition walls, for which as for the many piers occurring in the several stories it has manifestly been impracticable to make allowance.

As the inner surfaces of the outer and court walls were continued in the same vertical plane from the level of the ground floor to the eaves in the wings and to the third floor level in the ranges, the general horizontal dimensions would be identical in all stories, except the attics or lofts of the ranges, but for the fact that the addition of certain furring has reduced the width of the ranges in the third story, and the plaster work elsewhere has produced slight variations. Allowing for these differences, it may be said that the east and west wings have an average length of 216 feet 1 inch in all stories except the attic, which is unplastered and measures 216 feet 2 inches long. The length of the north wing through the center is 205 feet 2 inches in the first, second and third stories, and 205 feet 3 inches in the attic story, but in all stories except the attic the length is increased at the sides by the depth of the lateral projections of the north pavilion, which is 5 feet 11 inches.

None of the wings has a uniform width throughout its entire length, but all average 116 feet 2 inches wide at the outer end below the attic, in which this dimension is 2 inches greater. An offset of

about 3¾ inches is presented by each of the side walls adjoining the ranges. In the east and west wings there is naturally but one such offset, which occurs about 64 feet from the outer end of the wing and reduces its width by the amount of the projection over the remaining distance of about 152 feet to the wall of the rotunda. In the north wing there are two offsets, one on each side, at a distance of about 70 feet from the outer end, or at the juncture of its court wall with those of the ranges, and the reduction in the width of the inner part of this wing is double that in the other wings. In calculating the floor area of the wings allowance has also to be made for the piercings of the light wells above the main story.

The ranges furnish identical measurements in the ground, first and second stories in which the width is uniformly 54 feet 2 inches, and the total length of each range through the middle 316 feet 10 inches. In the third story the width is 51 feet 10 inches, and the length 314 feet 6 inches.

The south pavilion measures 111 feet 7 inches between its enclosing walls on both main axes, and 122 feet 1 inch on the diagonal axes, while the dimensions of the rotunda are 81 feet 6 inches on the main axes, measured between the screens, and 83 feet 5½ inches on the diagonal axes, measured between the great piers. In determining the total area of the main floor of the pavilion only the space occupied by the piers was excluded. The corridor back of the piers and screens is 12 feet 4¾ inches wide, and the same dimensions are repeated in the several galleries, but the extent of the third or upper gallery is increased by the open space, 43 feet 2 inches long by 19 feet 2½ inches wide, adjoining the large semicircular window on the south.

In computing the amount of space allotted to different purposes, the results of which are shown in the second and third tables which follow, the entire available floor area of the building has been accounted for. The exhibition space as given is clear of all obstructions other than the piers and screens, and the dimensions recorded for all parts of the south pavilion are wholly in the clear between walls. In the ground and third stories of the wings and ranges generally, however, the simple partition walls have been proportioned between the different assignments and included in their measurements, as have also the corridors which, owing to their width, are to a large extent available and already partly used for storage purposes. The spaces occupied by the stair wells and elevator shafts have naturally been repeated for each of the stories traversed, but in the aggregate their extent is relatively small for so large a building. The principal piercings occur in connection with the northern and the tower stairs. The former are practically square, measuring with the landings 22 feet 3½ inches by 22 feet 5¾ inches, but the latter are elongate and 13 feet 10½ inches wide by 35 feet 8½ inches long.

The apportionment of floor space by subjects, so far as it has been determined, is given in detail in the last of the tables, from which it will be observed that of the total of 468,118 square feet furnished by the building, 233,273 square feet, or one-half of the entire area, has been dedicated to the public, comprising, besides the exhibition halls in the wings and ranges, the main floor and galleries in the south pavilion, the auditorium, and the vestibule and lobby at the north entrance. The amount of space occupied for the storage of collections and for the laboratories is 158,989 square feet, and the remainder is divided between the heating and power plant, the shops for the maintenance and repair of the building and furniture, the business offices, the comfort rooms, housekeeping, the stairs and elevators, etc.

AVAILABLE FLOOR SPACE OF THE BUILDING

Wings and ranges.

	Square feet
Ground story.—East and west wings, each 24,995 square feet; north wing, 23,170 square feet; east and west ranges, each 17,052 square feet	107,264
First story.—East and west wings, each 24,995 square feet; north wing, 23,896 square feet; east and west ranges, each 17,052 square feet	107,990
Second story.—East and west wings, each 15,927 square feet; north wing, 14,794 square feet; east and west ranges, each 17,052 square feet	80,752
Third story.—East and west wings, each 16,475 square feet; north wing, 15,399 square feet; east and west ranges, each 16,192 square feet	80,733
Attic story.—East and west wings, each 16,606 square feet; north wing, 15,224 square feet	48,436

South pavilion.

Ground story, 11,684 square feet; first story, 11,490 square feet; second story, 5,605 square feet; third story, 5,695 square feet; fourth or attic story, 6,244 square feet	40,718
Total floor area of the building	465,893

South approach.

Vault enclosed by the masonry of the south approach	2,225
Total floor area of the building and approach	468,118

DIVISION OF SPACE BY STORIES

Ground story.

	Square feet	
North entrance: Vestibule, 763 square feet; lobby, 4,209 square feet	4,972	
Exhibition space: Central hall or foyer in north wing, 7,790 square feet; four rooms on sides of north wing, 4,616 square feet	12,406	
Laboratories and storage of collections: West wing, 16,366 square feet; west range, 16,260 square feet; east range, 11,278 square feet	43,904	
Meetings and lectures: Auditorium, 5,401 square feet; auditorium lobby, 1,163 square feet; two rooms on west side of north wing, used for small meetings, 1,710 square feet	8,274	
Library, east range	3,917	
Mechanical plant: Boilers, machinery, shops, coal bunker and driveway for delivery of coal, east wing, 15,885 square feet; ice machine and ventilating apparatus, south pavilion, 662 square feet; battery room communicating with north entrance lobby, 142 square feet	16,689	
Offices of buildings and labor, east range	1,512	
Offices of shipping, registration, property and supplies, with wagon entrance, landing platform, and corridors, west wing	7,555	
Construction and repair shops for furniture and building, east wing	6,284	
Storage space for property, supplies and mechanical appliances, east wing, 1,764 square feet; corridor on east, south, and west sides of south pavilion, 3,182 square feet; vault under south approach, 2,225 square feet	7,171	
Headquarters of the watch, communicating with the north entrance lobby	880	
Telephone exchange, west range	447	
Comfort, toilet, and locker rooms	4,128	
Housekeeping rooms, south pavilion	215	
Stairs, elevators, and elevator machinery	2,819	
Total area of ground story, including vault under south approach		121,173

First story.

Exhibition space: East and west wings, each 24,995 square feet; north wing, 22,862 square feet; east and west ranges, each 16,707 square feet; south pavilion, 9,873 square feet	116,139	
Small rooms: One in north wing, 357 square feet; four in south pavilion, 556 square feet	913	
Stairs and elevators	2,428	
Total area of first story		119,480

Second story.

Exhibition space: East and west wings, each 15,927 square feet; north wing, 13,760 square feet; east and west ranges, each 16,707 square feet; south pavilion gallery, 3,875 square feet	82,903	

	Square feet	
Small rooms: One in north wing, 357 square feet; five in south pavilion, 669 square feet	1,026	
Stairs and elevators	2,428	
Total area of second story		86,357

Third story.

Laboratories and storage of collections: East wing, 16,354 square feet; west wing, 8,534 square feet; north wing, 12,886 square feet; east and west ranges, each 15,847 square feet	69,468	
Exhibition space: South pavilion gallery	3,875	
General offices and adjoining corridor, west wing	7,820	
Toilet rooms, north wing	1,260	
Housekeeping rooms, north wing	333	
Four small rooms in south pavilion	759	
Stairs and elevators	2,913	
Total area of third story		86,428

Attic story.

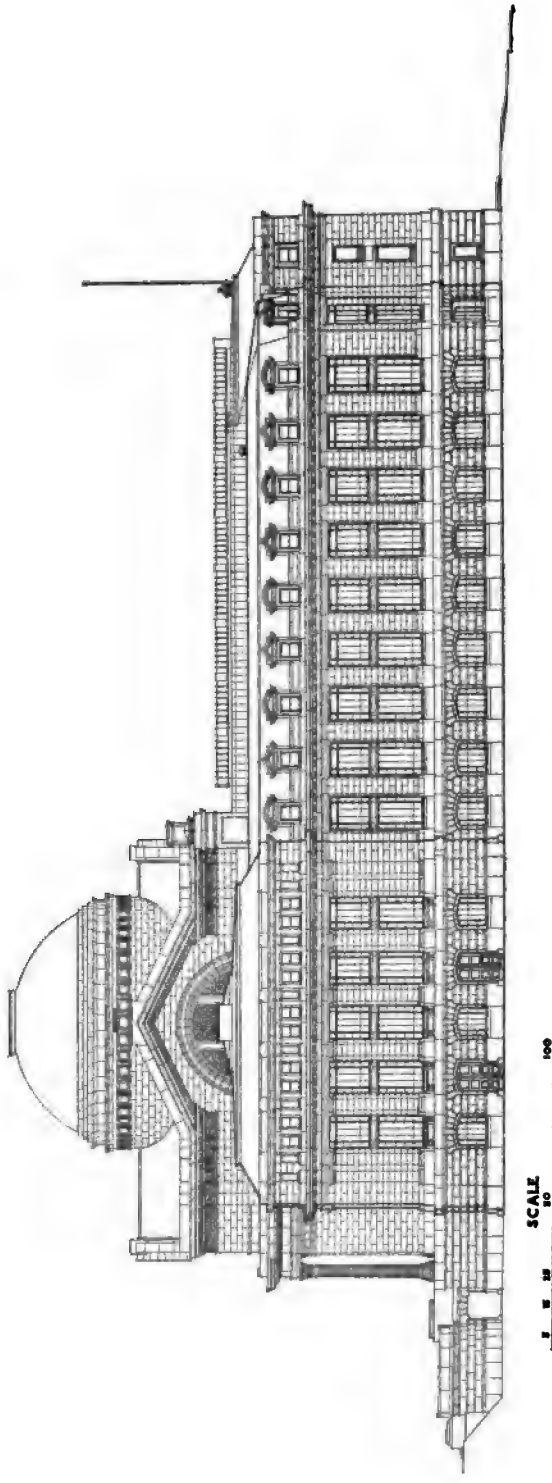
Storage of collections: East and west wings, each 15,798 square feet; north wing, 14,021 square feet	45,617	
Gallery in south pavilion, available for exhibition purposes	4,704	
Three small rooms in south pavilion	479	
Space occupied by ventilating chambers	2,262	
Stairs and elevators	1,618	
Total area of attic story		54,680
Total area of building		468,118

APPORTIONMENT OF SPACE BY SUBJECTS

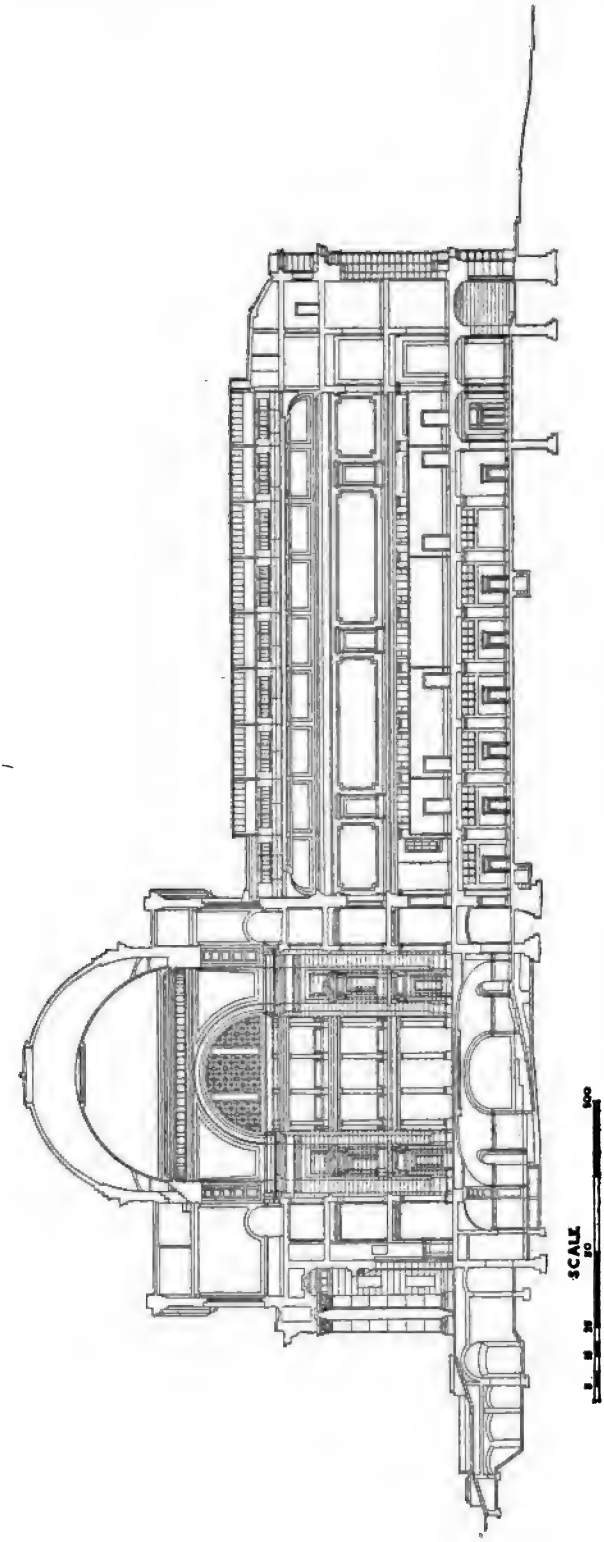
North entrance:		
Vestibule	763	
Lobby	4,209	
		4,972
Public exhibition space:		
Anthropology: Ethnology, part of north wing and northern sections of east and west ranges, first story, 35,474 square feet; archeology, north wing and east range, second story, 30,467 square feet	65,941	
Biology: Mammals and birds, west wing and western section of west range, first story, 31,764 square feet; reptiles, fishes, invertebrates and special installations, west wing and west range, second story, 32,634 square feet	64,398	
Geology: Systematic geology, eastern section of east range, first story, 6,769 square feet; applied geology and mineralogy, east wing, second story, 15,927 square feet; paleontology, east wing, first story, 24,995 square feet	47,691	
National Gallery of Art: Central part of north wing, first story	7,264	

	Square feet	
Public exhibition space—Continued.		
Not permanently assigned: Central hall in north wing, ground story, 7,790 square feet; four rooms at sides of same, 4,616 square feet; main floor and all galleries in south pavilion and rotunda, 22,327 square feet	34,733	
		220,027
Meetings and lectures:		
Auditorium and lobby, south pavilion, ground story	6,564	
Two meeting rooms, north wing, ground story	1,710	
		8,274
Laboratories and storage of collections:		
Ground story: Reptiles, fishes, and marine invertebrates, west wing	16,366	
Mammals, west range	16,260	
Vertebrate paleontology, preparators' workshops of geology and anthropology, east range	11,278	
Third story: Geology, mineralogy, invertebrate paleontology, and three rooms assigned to biology, east wing	16,354	
Birds, west wing	8,534	
Anthropology, archeology, and unassigned space, north wing	12,886	
Ethnology, physical anthropology, and invertebrate paleontology, east range	15,847	
Recent and fossil mollusks, insects, and two rooms assigned to anthropology, west range	15,847	
Attic story: Geology, east wing	15,798	
Biology, west wing	15,798	
Anthropology, north wing	14,021	
		158,989
Library:		
East range, ground story		3,917
General and miscellaneous offices:		
General offices, with adjoining corridor, west wing, third story	7,820	
Buildings and labor, east range, ground story	1,512	
Shipping, registration, property, and supplies, including inner driveway, landing platform, and adjoining corridors, west wing, ground story	7,555	
Watch force, north pavilion, ground story	880	
Telephone exchange, west range, ground story	447	
		18,214
Construction and repair:		
Construction and repair shops for furniture and buildings, east wing, ground story		6,284
Storage of property, supplies, and mechanical appliances:		
East wing, ground story	1,764	
Corridor on east, south, and west sides of south pavilion, ground story	3,182	
Vault under south approach	2,225	
		7,171
Mechanical plant:		
Boilers, machinery, shops, coal bunker and driveway for delivery of coal, east wing, 15,885 square feet; ice machine and ventilating apparatus, south pavilion, 662 square feet; battery room, communicating with north entrance lobby, 142 square feet; all in ground story	16,689	
Space occupied by ventilating chambers, attic story	2,262	
		18,951

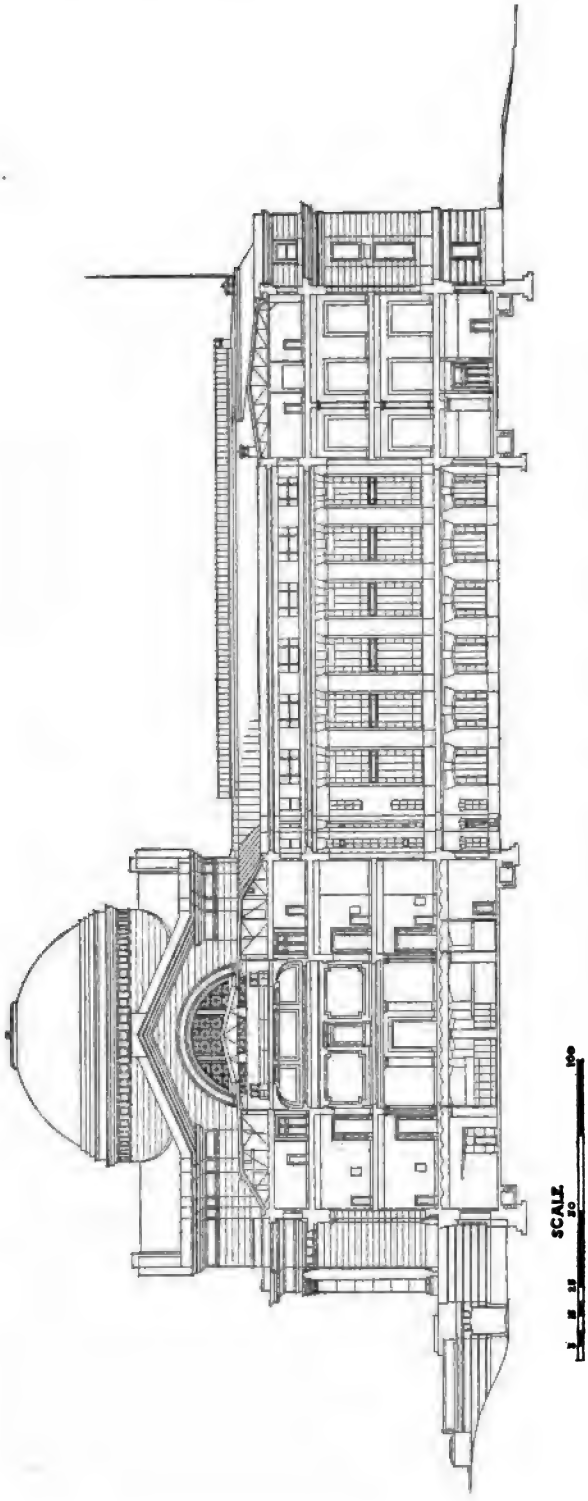
	Square feet
Comfort, toilet, and locker rooms:	
Ground and third sories	5,388
Housekeeping rooms:	
Two rooms in ground story and two in third story, besides several others temporarily assigned, the area of which is not included here	548
Unassigned rooms:	
A number of small rooms on the south side of the south pavilion and in the north pavilion not definitely assigned but used for various purposes	3,177
Stairs, elevators, and elevator machinery:	
Space occupied by stair wells, elevator shafts, and elevator machinery in all stories	12,206
Total area of building	468,118



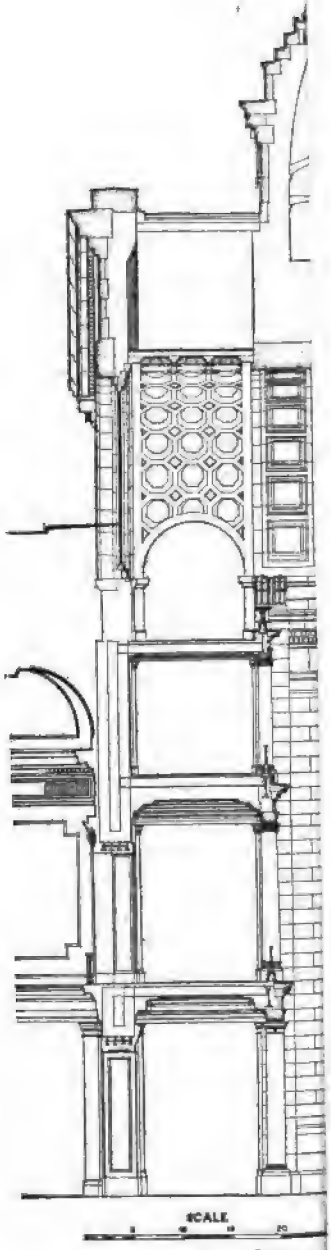
EAST ELEVATION OF BUILDING.



SECTION OF BUILDING ON NORTH AND SOUTH AXIS, LOOKING WEST.



SECTION OF BUILDING ON NORTH AND SOUTH LINE THROUGH THE EAST COURT, LOOKING WEST.



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